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Book 15
Subsurface Water Data

Seafarer Site Survey
Upper Michigan Region

for
U.S. Navy
Naval Electronic Systems Command
Washington, D.C.

by
EDAW inc.
under contract to
GTE Sylvania
Communication Systems Division

BOOK 15

SUBSURFACE WATER DATA
of the
UPPER MICHIGAN REGION
PROJECT SEAFARER

for
U. S. Navy. Naval Electronic Systems Command

by
EDAW, Inc., 50 Green Street, San Francisco 94111

Under Contract to
GTE Sylvania, Communication Systems Division

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CONTENTS

SUBJECT	PAGE
Summary	1
Evolution	3
Processes and Time Leading to Existing Conditions	3
Anticipated Future Conditions	4
Distinctive Units and Characteristics	5
Depth to Water	5
Quality of Water	5
Aquifer Units	8
Ground Water Conditions in the Various Counties	10
Relationship to Other Data	23
Depth to Water	23
Quality of Water	23
Aquifer Properties and Yields	26
Validity	28
General Procedures	28
Data Sources	28
Data Reliability/Limitations	29
Bibliography	30
DATA MAP	
Subsurface Water Data Map	6
TABLES	
Table 1. Legend-Depth to Water in Wells	7
Table 2. Recommended Limits for Drinking Water	8
APPENDICES	
Appendix A. Records of Wells in Study Area	31
Appendix B. Well Yields	61
Appendix C. Water Quality	68

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A Subsurface Water Data Map has been prepared which shows locations of representative wells within the Study area, depth to water, and the quality of water available. The water table is near the surface with water encountered in most excavations greater than ten feet in depth. Water yields from wells vary considerably throughout the area ranging from a few gallons to tens of gallons per minute.

The most promising areas for large scale ground water development appear to be areas of stratified glacial outwash sands and gravels along major streams where yields of several hundred gallons per minute are possible.

SUMMARY

The Subsurface Water Data Map shows locations of representative wells within the Study Area, depth to water at these locations, and the quality of the water present. The amount of subsurface water that can be extracted by wells within the Study Area varies greatly. Wells extract water both from bedrock aquifers and from glacial deposits that exist at the surface throughout most of the area. Moderate yields (a few tens of gallons per minute) are generally available from wells penetrating the Paleozoic sandstones and limestones at the southeast and northwest margins of the Study Area, but the older Precambrian crystalline rocks underlying the central portions of the area are generally dense and impermeable so that they yield very small amounts of water to wells. Consequently, near-surface glacial deposits may be the only available sources of ground water within areas of Precambrian bedrock. In other portions of the area where limestone and sandstone strata exist at depth, both the glacial deposits and the bedrock may serve as aquifers.

The glacial deposits vary greatly in composition according to their method of deposition. Coarse sands and gravels exist in some areas, while clayey lake deposits and till underlie others. The most promising areas for large-scale ground water development appear to be areas of stratified glacial outwash sands and gravels along major streams where yields of several hundred gallons per minute are possible from the fairly coarse and uniform sands and gravels present. In contrast, it may be difficult to obtain a few gallons per minute for a small domestic supply in some of the areas where dense Precambrian bedrock crops out at the ground surface, or where the glacial deposits are thin and/or clayey.

The water table is near the ground surface (0 to 10', 20', or 30') in much of the area. In some areas, however, depth to water is variable, ranging from a few feet in valleys underlain by glacial deposits to in excess of 100' in upland areas underlain by bedrock. There does not appear to have been any long-term rise or fall in ground water levels within most of the Study Area, although some local areas have probably experienced a lowering of the water table due to large-scale pumping operations in connection with mining activities. Water will be encountered in most excavations greater than 10' in depth. In excavations within Precambrian areas underlain by extensive thick glacial deposits of high permeability, such as outwash materials, flows of several hundred gallons per minute may be encountered.

The quality of the ground water throughout the Study Area is generally good. The only two minor water quality problems frequently encountered are hardness and excessive iron concentrations, both of which can usually be alleviated by standard water treatment methods. Some of the deeper (300' to 400') wells in bedrock produce water that is somewhat salty (250 to 400 ppm chloride). Also, there is some possibility of bacterial contamination of shallow aquifers by surface pollution sources, particularly within areas underlain by the Paleozoic limestone aquifers at the eastern and southeastern edges of the Study Area.

Areas underlain by coarse-grained glacial deposits, such as outwash, and by the more promising Paleozoic aquifers could support fairly extensive additional ground water development. Consequently, although the Precambrian rocks are capable of only very limited yields, in most areas the overlying glacial deposits would serve as a source of substantial amounts of ground water. Due to the variability in composition and thickness of the glacial deposits, it will probably be necessary to perform geophysical investigations and test drilling/test pumping operations to correctly locate future wells.

EVOLUTION

Processes and Time Leading to Existing Conditions

Ground water in the Study Area is found in both bedrock aquifers and in overlying unconsolidated deposits of glacial origin. Within the dense Precambrian rocks and the Paleozoic limestones and sandstones, water occurs in and moves through openings such as joints, fractures, and solution cracks. Many of these rocks had low porosities and permeabilities when they were first formed so that they could not readily store or transmit water. However, both porosity and permeability have been increased over long periods of time. For instance, the movement of water along joints in limestone formations gradually dissolves weaker portions of the rocks, and solution cavities and fissures are formed--openings which enable the limestone to function as an aquifer.

Within the unconsolidated glacial drift materials overlying the bedrock, water is found in the spaces between the grains of the material, and these deposits function as aquifers as soon as they are deposited. Materials such as outwash sands and gravels have undergone a sorting process while being transported by glacial melt-waters. Because of this sorting, the resulting deposits are stratified (deposited in layers) and some layers are composed of materials which are both reasonably coarse and fairly uniform in size. Deposits such as this have both high porosity and high permeability. Consequently, they can readily store and transmit large quantities of water and are excellent aquifers.

Conversely, lake bed deposits which formed in areas of ponded meltwater may be composed of predominantly fine-grained material such as clay or silt. They consequently have low permeabilities and generally are poor aquifers.

As water percolates through the aquifers, it dissolves minerals contained within the deposits. Thus, the chemical quality of the ground water is influenced by such factors as material type and the amount of time the water has been in contact with the aquifer. Much of the ground water within the Study Area is a calcium-magnesium-bicarbonate type that is rather hard because many of the aquifers through which the water has been moving (particularly the limestones) are rich in calcium and magnesium carbonate. The ground water also has significant concentrations of iron because the rocks and glacial deposits are rich in this metal in many areas.

The Study Area is sparsely populated, and man has probably had little effect on either the quality or quantity of ground water in most portions of the area. The principal water quality problems--hardness and excessive iron--are a reflection of natural processes. A few exceptions where man has affected the ground water regime exist, however. Bacterial contamination of shallow aquifers, particularly limestones, has occurred in isolated areas. The source of this pollution is probably barnyard waste or septic tank effluent. Large-scale pumpage of water flowing into mines has also caused lowering of the water table in the immediate vicinity of pumping operations. In some areas, where mining operations and the accompanying pumping have ceased, the natural ground water regime has been reestablished and water tables have risen. This has caused problems such as flooding of basements which were constructed during the time the water table was artificially lowered.

Anticipated Future Conditions

In the absence of large-scale development in the Study Area, it is unlikely that significant changes in either quantity or quality of ground water will take place within the foreseeable future. Ore beneficiation activities, particularly in the Iron Range area of Marquette County require fairly significant amounts of water, and significant increases in this industry could mean an increased demand upon available water resources. Water used in the ore beneficiation processes generally becomes degraded somewhat in quality, but it is usually passed through settling basins prior to being returned to streams. Additionally, in most instances the natural dilution process which occurs in the streams significantly reduces the contamination in a fairly short distance downstream.

Although the Precambrian rocks in the center of the Study Area are capable of yielding only small supplies of water, it is likely that the Paleozoic aquifers and many of the glacial drift deposits overlying the bedrock could support fairly extensive ground water withdrawals without adversely affecting the quantity of water available. Most of these aquifers are not extensively developed at present, and could support many more wells. However, the optimum development of ground water supplies (particularly in the heterogeneous glacial drift deposits) will require careful study and investigation to achieve the best results and to ensure that both subsurface and surface water supplies are not adversely affected. Obviously, any development which resulted in large amounts of waste water being generated and discharged into the ground could result in deterioration of ground water quality, and treatment of such discharges would be necessary.

DISTINCTIVE UNITS AND CHARACTERISTICS

Depth to Water

The Subsurface Water Data Map shows the locations of representative wells within the Study Area, along with information on the depth to water and ground water quality. Each well is assigned an identification number according to the well-numbering system commonly used in Michigan. The first two parts of the well number designate township and range, the third part of the number designates both the section number and the number of the individual wells within the section, and the fourth and fifth parts of the number indicate the location of the well down to the specific quarter-quarter section (40 acres) within which it is located. For example, a typical well number might read as follows: T44N R27W 17-1 NW SE. This number indicates well number one in section 17, Township 44 North, Range 27 West. In addition, NW SE indicates that the well is located in the northwest quarter of the southeast quarter of section 17. Identification numbers do not appear on the map, however, as they can be readily indexed by using the Michigan System.

The depth to water in each well is shown by the coding system presented in Table 1. Wells are grouped into 10' class intervals for depths up to 40', and into 20' class intervals for depths ranging from 40'-100'. Springs are indicated by the letter "S". Detailed information on each well appears in the Appendix. Where numerous wells are shown within a 40 acre area, only the range in depth and quality are indicated.

The water table is generally fairly shallow (0 to 10', 20' or 30' in depth) within the Study Area. Ground water is very close to the surface in valley areas, particularly in glacial drift deposits. Some hilltop wells have depths to water of more than 100'.

Quality of Water

Nine important ions were selected, and wells having excessive amounts of these ions are shown by a coding system on the Subsurface Water Data Map. Since the water quality in the Study Area is good, in almost all cases the only important ion in excessive amounts was iron. This is the result of iron-rich bedrock and glacial deposits in parts of the area, which sometimes cause the iron concentration in the ground water to exceed the recommended limit of 0.3 mg/l. Although not coded on the map, another water quality problem in the

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Washington, D.C.

6 Mile Square

Scale 0 1 2 4 6 miles

North

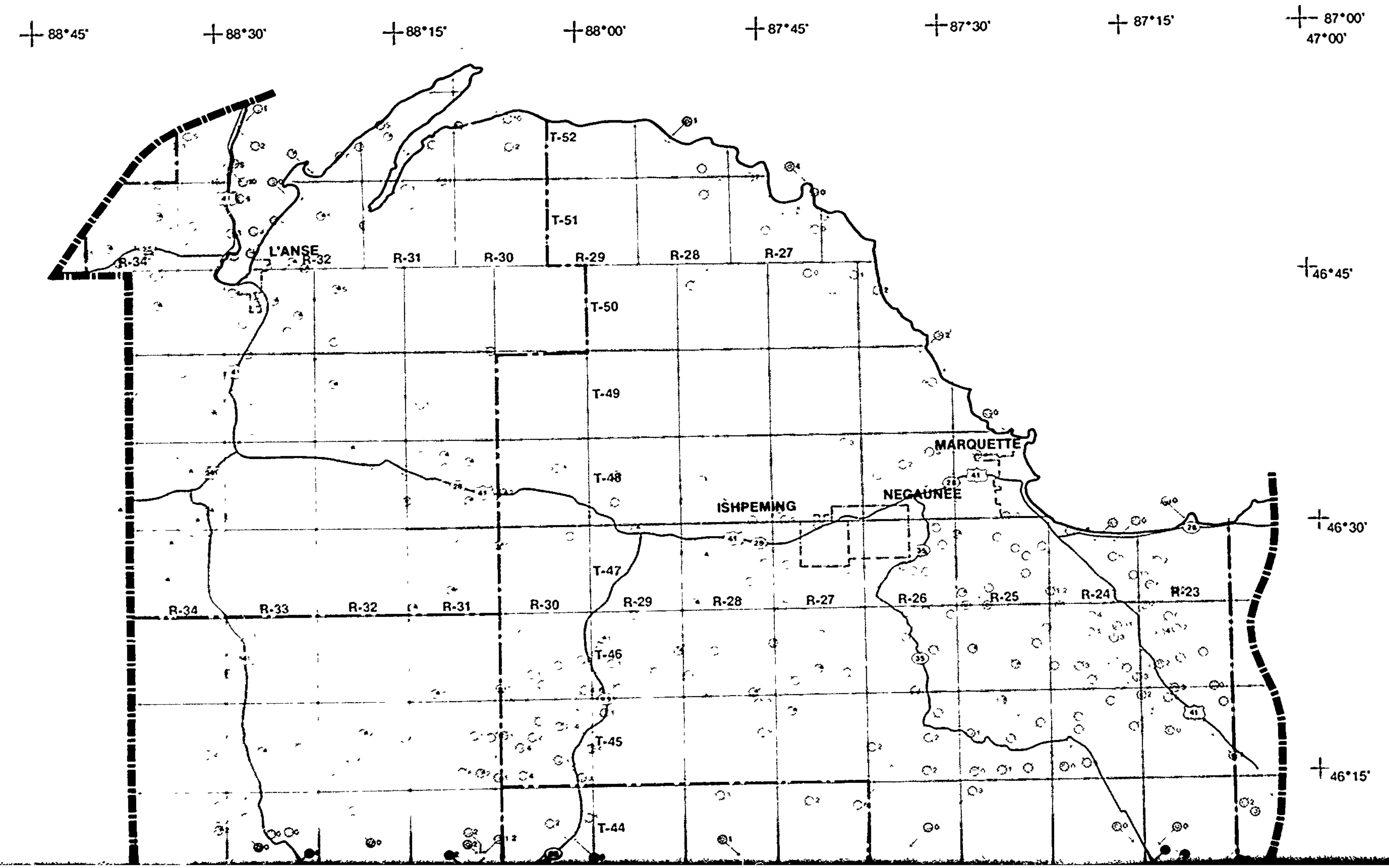
SUBSURFACE WATER

WELL LABELING SYSTEM
- Water Quality
- Well Depth (See Text)
- Well Location

WATER QUALITY (Ion Content)

NO_3 - Nitrate
Cl - Chloride
SO_4 - Sulfate
HCO_3 - Bicarbonate
Ca - Calcium
Mg - Magnesium
Na & K - Sodium & Potassium
Fe - Iron

Solid Sections Indicate an Ion Content Exceeding U.S. Public Health Dept. Standards (See Text)



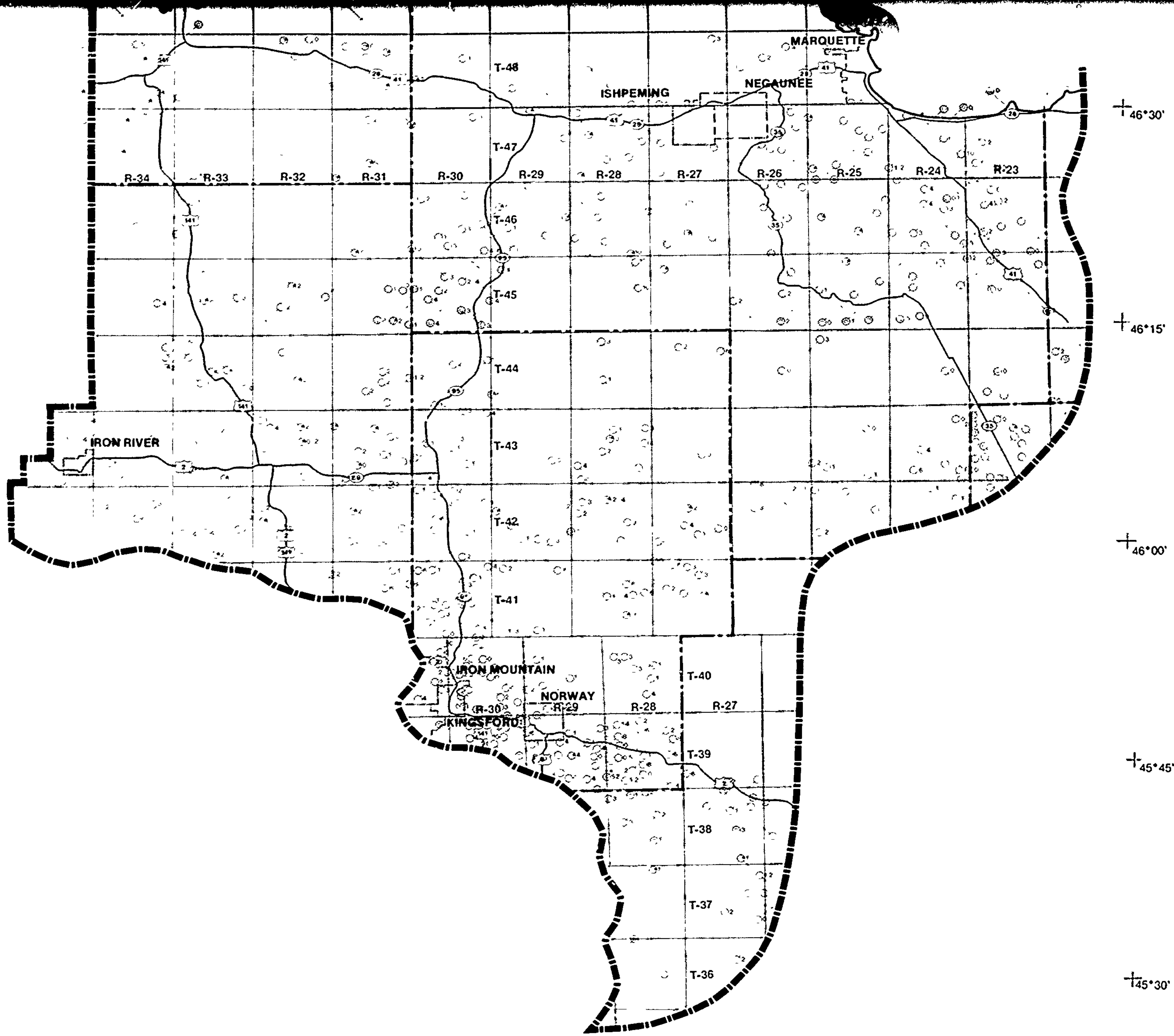

MARQUETTE
NEGAUNEE
ISHPEMING
IRON RIVER
IRON MOUNTAIN
NORWAY
KINGSFORD
T-48
T-47
T-46
T-45
T-44
T-43
T-42
T-41
T-40
T-39
T-38
T-37
T-36
R-34
R-33
R-32
R-31
R-30
R-29
R-28
R-27
R-26
R-25
R-24
R-23
46°30'
46°15'
46°00'
45°45'
45°30'

Table 1. LEGEND - DEPTH TO WATER IN WELLS

Spring	S
0-10 ft.	0
11-20 ft.	1
21-30 ft.	2
31-40 ft.	3
41-60 ft.	4
61-80 ft.	6
81-100 ft.	8
100 ft.	10

Study Area is high hardness values. Information on hardness is included with the detailed chemical analysis data of well water samples in Appendix C. The recommended limits for the various principal ions and for total dissolved solids appear in Table 2.

Table 2. RECOMMENDED LIMITS FOR DRINKING WATER*

Constituent	Limit in milligrams/liter
Total dissolved solids	1,000
Calcium (Ca)	200
Magnesium (Mg)	125
Sodium (Na)	200
Potassium (K)	10**
Bicarbonate (HCO_3)	500
Sulfate (SO_4)	250
Chloride (Cl)	250
Nitrate (NO_3)	45
Iron (Fe)	0.3

*Abstracted from U. S. Public Health Service, Publication No. 956 and other sources.

**No limit clearly defined for potassium; however, most potable ground water contains less than 10 milligrams/liter.

Aquifer Units

The various aquifer units can be divided into two broad categories--bedrock and overlying surficial deposits--the latter generally of glacial origin. Although glacial drift is used as a general term to describe deposits which are of glacial origin, it is possible to further subdivide the glacial deposits into the principal surficial aquifer units based upon their composition and mode of formation. (Note: A more detailed description of the aquifer units listed below is presented in the Surficial Geologic Data and Bedrock Geologic Data reports.)

Surficial Deposits

Till Plains: Deposits with a flat or gently rolling surface which were deposited directly from the melting ice. Till plains can also be called ground moraines. Till is composed primarily of unsorted and unstratified mixtures of sand, silt, clay, and gravel. There are sometimes pockets or lenses of sand and gravel which occur within the unsorted till material.

Lake Bed Deposits: Deposits of silt, clay, and fine sand deposited in glacial lakes which formed from meltwater issuing from the glaciers. While these deposits are generally of low permeability and produce only small amounts of water, they sometimes overlie other more permeable deposits of sand or gravel which can be utilized as water sources.

Swamp Deposits and Recent Alluvium: These deposits are found along streams and in broad lowland areas. They consist of deposits of peat and muck, and sometimes also include or overlie sand and gravel deposits.

Outwash: Outwash is composed mainly of stratified deposits of sand and gravel, although scattered lenses of silt and clay may also be present. These are deposits which have been carried by braided streams or sheet runoff of meltwater issuing from the glacier front. Outwash plains are generally flat or gently sloping areas. Because of the sorting of the material as it is carried by the meltwater, the deposits are usually fairly permeable, and often are the most productive of the glacial aquifers.

Bedrock Aquifers

Trenton and Black River Limestones: Thin, irregular beds of gray to buff limestone and dolomite, including some interbedded shale and shaly limestone and dolomite. This unit is of Ordovician age and contains water in interconnected openings along bedding planes and fractures. Many of these openings have been enlarged by solution. Near-surface zones of the Trenton and Black River Limestones are sometimes subject to contamination from surface pollution sources.

Undifferentiated Dolomites, Limestones, and Sandstones of late Cambrian to early Ordovician age: These rocks consist of beds of limestone and dolomite, sandstone, sandy and shaly dolomite, and dolomitic sandstone. Both the limestone and sandstone beds yield water to wells.

Munising Sandstone: The Munising Sandstone is of Cambrian age, and is a fine, medium, and coarse-grained white, buff, and gray sandstone. The Munising contains some lenses of silt and shale and some conglomerate at the base.

Jacobsville Sandstone: This medium-grained quartz sandstone is of Cambrian or possibly Precambrian age, and is generally light red to brown in color, sometimes mottled and streaked with white and sometimes containing beds of fine-grained sandstone, shale, and conglomerate. The Jacobsville Sandstone is one of the most important bedrock aquifers in the area and, where glacial drift is thin or absent, may be an important source of water in some locations.

Precambrian Rocks: These are igneous, metamorphic, and sedimentary rocks which generally underlie the younger Paleozoic limestones and sandstones, and the glacial deposits. They generally have low porosity and permeabilities, and are consequently not important aquifers. Better yields can usually be obtained from the younger consolidated and unconsolidated aquifers which overlie the Precambrian rocks.

Ground Water Conditions in the Various Counties

Because the main source of ground water data is a series of reports, each dealing with the ground water resources of a particular county, the county-by-county approach has been used in discussing the ground water resources of the Study Area.

Terms which are used in the discussion are defined as follows:

Water hardness scale:

soft	less than 60 mg/l hardness expressed as $CaCO_3$
moderately hard	60 to 120
hard	120 to 200
very hard	over 200

Well yield scale:

small yields	1 to 10 gpm
moderate yields	10 to 100
large yields	over 100

When the term "objectionable" or "excess" iron is used, it generally means iron concentrations greater than 0.3 mg/l. This is the limit suggested by the U. S. Public Health Service, and larger concentrations cause staining of laundry, sinks, and utensils, in addition to causing unpleasant taste and promoting the growth of iron bacteria.

Alger County

Only a narrow strip along the western edge of the County is within the Study Area. Surficial deposits within the northern third of this strip consist of glacial lake deposits which generally form only a thin veneer over high points in the underlying bedrock. Thicker deposits may be found locally where valleys or depressions exist in the bedrock surface. These lake deposits are generally well sorted, permeable sand. They form fairly important local sources of water where present in sufficient thickness, with yields of 10 to 20 gpm obtainable from properly constructed wells.

The surficial deposits mantling the southern two-thirds of the strip within the Study Area form a gently undulating till plain. The glacial drift deposits beneath this plain are generally quite thin, and the underlying bedrock is exposed along some road cuts as well as along the bottoms of many of the streams. This till plain consists of a poorly sorted mixture of sand, silt, clay, and rock. Because the till is thin and has generally low permeabilities, it is not an important source of water.

Directly underlying the till in this southern portion of the strip are the Trenton and Black River Limestone Formations. These rocks are the principal source of water in this part of the County. Water is found along joints, fractures, and bedding planes, especially where these openings have been enlarged by solution. Because the glacial drift deposits are thin, many of the wells which take water from the Trenton and Black River Limestones are less than 50' deep, and most are less than 100' deep. These formations yield small supplies of water for domestic and farm use, and locally can yield up to 20 gpm, particularly if wells are located near streams so that recharge from the stream can take place. The Trenton and Black River Formations produce water which is hard to very hard, and some wells also produce water containing excessive iron. The principal quality problem, however, is bacterial rather than chemical. These formations generally lie at a shallow depth so that there is little opportunity for filtration of organic pollutants which may originate from surface or near-surface sources such as barnyard waste and septic tank effluents. The relatively large fissures in the limestone are not able to provide the same type of filtering action which normally occurs as bacterially contaminated water moves through appreciable thickness of granular materials such as sand and gravel. The thickness of the Trenton and Black River limestones ranges from a few feet at the north edge (approximately at Township 45 North) to over 200' in the southwestern corner of the County.

In the west-central part of the County, sandstones and dolomite of Cambrian and Ordovician age are the main source of water. The sandstone beds in the Cambro-Ordovician sequence tend to be thinner or are absent in the western part of the County, and most of the wells tapping these rocks take water from crevices and solution openings in the beds of dolomite, with yields of up to 50 gpm in some areas. The dolomites and sandstones are probably from 150' to 200' thick and produce water of good quality. The water from the dolomite portion of the sequence tends to be harder than that from the sandstone, although both the dolomite and the sandstone produce water which is softer than that from the overlying Trenton and Black River limestones and harder than that from the underlying Munising sandstone, which is of Cambrian age. This unit varies from 50' (southern Alger County) to 200' in thickness at its northern edge (approximately T46N). This formation consists of well sorted and weakly cemented sands of moderate permeability. The Munising sandstone has not been extensively developed as a source of ground water, although small to moderate yields would be possible from this unit.

In the northwestern part of the County, the Jacobsville sandstone of Cambrian to Precambrian age lies at shallow depth beneath the glacial lake deposits previously discussed, and is the principal aquifer in the area. Because the Jacobsville is a well cemented sandstone, its primary permeability is low; however, it has a fairly high secondary permeability due to openings along joints, fractures, and bedding planes. The Jacobsville attains thicknesses as great as 1,000' along the Lake Superior shoreline at the north edge of Alger County, although it becomes thinner to the south, and disappears entirely in southern Alger County. Most of the wells tapping the Jacobsville are less than 100' deep. The Jacobsville sandstone produces water which is generally moderately hard to hard, and in some areas it contains objectionable amounts of iron, although the excessive iron is satisfactorily reduced to acceptable levels by commonly used treatment methods. Some of the deeper wells in the Jacobsville produce water having a high chloride content, so that it is generally advisable in western Alger County to complete wells in the Jacobsville at as shallow a depth as is practical.

It is likely that detailed investigations would be required to develop water supply systems producing more than 50 gpm in Alger County.

Delta County

The only portion of Delta County which falls within the Study Area is the extreme northwest corner. The surficial deposits in this part of the County consist mainly of fairly thin till plain deposits consisting of poorly sorted clayey material which generally has a low permeability. Consequently the only important aquifers in the area of interest are the bedrock aquifers lying beneath the thin mantle of glacial drift.

The main source of water in western Delta County is the Trenton and Black River limestones, and moderate amounts of water are available from these bedrock aquifers. The water is of the calcium-magnesium-bicarbonate type and is hard. In some areas, the Trenton and Black River Formations produce water which has a high chloride content. The thickness of these limestones varies from 150' to 300'. The specific capacity of wells tapping these limestones is generally low, and large yields are generally not obtainable from them.

Lying beneath the Trenton and Black River limestones but above the Precambrian rocks are the Munising sandstone and the Au Train Formation, a potential water source which may be treated as a single aquifer. The Munising sandstone, which ranges from 50' to 200' in thickness, is cemented with silica and is overlain by the Au Train Formation, a 300' thick sequence of thin to medium-bedded sandy dolomite and dolomitic sandstone containing lenses of quartz sand. Although the sandstone beds yield the majority of the water from the Munising and the Au Train, some water is also obtained from fractures and solution openings in the dolomite beds of the Au Train Formation. Some of the wells tapping the sandstone flow at the surface due to artesian pressure, and yields as great as 250 gpm have been reported. The Munising sandstone produces a calcium-magnesium-bicarbonate water which is generally of good quality. The Au Train Formation yields a similar type of water, although water from the more dolomitic parts of the Au Train Formation tends to be somewhat harder.

In general, development of ground water resources in Delta County will involve problems of water quality rather than problems in location of adequate quantities of water. Wells tapping both the Trenton and Black River limestones, and the underlying Munising and Au Train Formations have relatively high yields.

Menominee County

The Northwestern third of Menominee County lies within the Study Area. The surficial deposits in most of this northwestern part of the County consist of till plains, drumlins (low, smoothly rounded, elongated and oval hills whose long axis parallels the direction of movement of the glacier), and shallow outwash deposits. These surficial deposits are a mixture of clay, silt, sand, and gravel, generally less than 40' thick, but as much as 100' thick beneath some of the larger drumlins. The glacial deposits in the northern part of the County tend to be more sandy than those in central and southern Menominee County, and properly constructed wells may yield as much as 50 gpm from these deposits in some places.

Portions of the western edge of the County are underlain by moraine, which tends to be thicker and sandier than the glacial deposits in the central part of the County, and locally includes thick and extensive beds of sand and gravel. Properly constructed, large (8"-12") diameter wells yield 100 to 200 gpm from these deposits, which are potentially an important source of water.

Although significant yields are possible from wells tapping the glacial deposits, most wells obtain their water from the underlying bedrock aquifers. The uppermost bedrock units in much of the western part of the County are limestone and dolomite, sandy and shaly dolomite, and dolomitic sandstone. The sandstone beds are thicker and more extensive in the northern part of the County, and range in thickness from 0 to 300'. Wells tapping these aquifers are from 30' to 200' deep, average 70' to 80', and are mostly less than 100' in depth. The wells tapping these limestones and sandstones generally obtain yields of only 5 to 10 gpm; however, some wells may produce as much as 50 gpm. Water from this unit is generally of good quality, although it is hard, and in some areas contains objectionable amounts of iron. Both the hardness and excessive iron are amenable to treatment.

Lying beneath the Cambro-Ordovician limestones and sandstones are sandstones of Cambrian age. This unit consists of pink, gray, and white sandstone. The thickness varies from 200' in the southern part to 50' in northern part of Menominee County. Because these sandstones are overlain in most areas by shallower and more accessible aquifers (e.g., Cambro-Ordovician limestones and sandstones and glacial deposits), they are not generally very important for small domestic supplies of 5 to 10 gpm. They have considerable potential for moderate to large supplies, however, and properly constructed wells which were deep enough to tap the Cambrian sandstone could yield as much as 100 to 200 gpm. Wells presently tapping this sandstone for municipal or industrial use are about 400 or more feet deep. The quality of the water from this sandstone is generally good, low in iron content, and of moderate hardness.

The lowermost bedrock unit consists of rocks of Precambrian age, such as granite, schist, marble, and iron formations. The Precambrian rocks crop out in a narrow band along the west edge of the County. The Precambrian rocks are not important aquifers except in local areas in western Menominee County, where the glacial drift is thin or absent. In such areas, the Precambrian rocks yield small supplies of water from fractured and broken zones. Little is known about the chemical quality of water from the Precambrian rocks because so few wells tap this unit. One sample obtained from a well located at the west edge of the County was of good quality, with a total dissolved solids content of 315 ppm and a hardness of only 76 ppm.

In Menominee County, the natural ground water discharge from aquifers (spring flow) far exceeds present ground water pumpage so that there is a good potential for development of ground water resources in the County.

Marquette County

The economy of Marquette County is geared to the iron ore industry, and because of the water requirements in ore beneficiation processes, fairly heavy demands are made upon the water resources of the area. Almost all of this County lies within the Study Area.

The aquifers consist of bedrock, overlying glacial drift and alluvium. The bedrock is primarily of Precambrian age, although there are some areas of Cambrian sandstone in the eastern and southeastern part of the County. The glacial deposits consist of relatively thin till deposits overlying the bedrock and also areas of fairly thick outwash deposits (up to 250' thick). The yields from Precambrian bedrock tend to be low, as these rocks generally have low porosity and permeability. The water supply potential of the glacial drift aquifers is related to both their composition and thickness. The best sources for ground water development are thick glacial outwash and alluvial deposits, while the least favorable areas are those in which Precambrian bedrock is overlain by only a thin mantle of glacial drift.

In the area southeast of Goose Lake, there is a fairly extensive outwash deposit consisting mainly of sand. Knobs of bedrock exposed in the outwash plain indicate a very irregular bedrock surface lying beneath the outwash deposits. However, the outwash material attains a thickness of as much as 240' in some areas. The depths to water in this material range from less than 5' to about 150'.

A pumping test conducted with a flowrate of 310 gpm and a duration of 15 hours in the outwash material indicated a coefficient of transmissibility of 130,000 gallons/day/foot and a storage coefficient of 0.16. The coefficient of transmissibility is an indication of the ability of the aquifer to transmit water, and values in excess of about 10,000 gpd/ft. generally indicate that wells will be able to supply municipal or industrial use. The storage coefficient gives an indication of the capacity of the aquifer to store water and generally ranges from about 0.01 to 0.35 for water table aquifers such as the glacial drift materials.

In the Humboldt area east of Lake Michigamme, the outwash has a saturated thickness of as much as 100', and pumping tests in this area indicate that the coefficient of transmissibility ranges from 7,000 to 20,000 gpd/ft. and averages about 12,000 gpd/ft.

Another area of extensive outwash deposits is in the West Branch Creek area east of Republic. The outwash in this area attains thicknesses of up to 160', and depths to water range from less than 10' to nearly 60' in this material. The coefficient of transmissibility in this area ranges from about 10,000 to 30,000 gpd/ft. Many stream valleys in this area contain deposits of outwash and alluvium which might provide moderate supplies of water. In the outwash and alluvial deposits, the total dissolved solids generally range from about 25 to 260 ppm.

In USGS Water Supply Paper 1842 by Wiitala, et al. (1967), results of chemical analyses of ground water from the Marqutte-Iron Range area are presented, which indicate that the outwash or alluvium produces soft to moderately hard water, with nearly one-half of the wells tapping these deposits having soft water (60 ppm or less). The most objectionable constituent of water from wells in the area covered by the report was iron. Of 37 samples analyzed for iron, more than half exceeded the recommended limit of 0.3 ppm, and about one-third had in excess of 1 ppm of iron. When the iron concentration is as great as 1 ppm, there is a possibility of precipitate formation and clogging of pipes. The maximum iron concentration found in waters from the outwash materials in the Iron Range area was 8.1 ppm.

Although detailed information on the water supply characteristics of the Cambrian sandstones which overlie the Precambrian rocks in the eastern part of the Marquette-Iron Range area was not given in Water Supply Paper 1842, it is probable that these sandstones would produce small to moderate yields from fractures and other openings.

Because the majority of Marquette County is underlain by dense Precambrian bedrock, the overlying glacial deposit aquifers are the most important sources of ground water, and the most promising areas are those where fairly extensive and thick outwash and alluvial deposits are found.

Dickinson County

Dickinson County lies completely within the Study Area, and the bedrock under most of the County is made up of igneous and metamorphic rocks of Precambrian age. Along the east edge of the County, the Precambrian rocks are overlain by sandstones of Cambrian age and sandy dolomites and dolomitic sandstones of Cambrian and Ordovician age.

Large diameter wells penetrating over 50' into these Cambro-Ordovician rocks may yield up to 50 gpm. If satisfactory yields are not obtained, wells may be deepened to penetrate the underlying Cambrian sandstones. In the Cambrian sandstones, large diameter wells which penetrate over 50' into the sandstone may yield as much as 100 gpm. The thickness of these Cambrian and Cambro-Ordovician deposits ranges from perhaps 100' at the east edge of the County to zero at approximately the west edge of Range 27 West.

In areas further west where the bedrock is of Precambrian age and crops out at the surface or has only a thin covering of glacial deposit, the potential for development of high capacity wells is poor. Although specific capacities of as much as 5 gpm/ft. of drawdown have been reported in wells tapping the Precambrian, most wells have a specific capacity of less than 1 gpm/ft. In the areas where the Precambrian bedrock crops out or lies at a shallow depth, the most promising areas for wells are generally in the valleys where there is more likely to be somewhat thicker glacial deposits and more extensively weathered zones in the bedrock. If more than 20' of permeable glacial deposit overlying the bedrock is present, domestic supplies of a few gpm may be developed, and a few wells may yield more than 10 gpm. Because joints and fractures in the Precambrian bedrock tend to become smaller and less extensive with depth, it is generally futile to drill more than about 100' into bedrock.

In other areas of the County where thicker outwash deposits of sand and gravel overlie the Precambrian bedrock, wells over 12" in diameter may produce yields in excess of 100 gpm. The best sites for wells in outwash deposits are in valleys, on low terraces, or along streams where the potential for recharge is good.

Another surficial deposit found in Dickinson County is that of sandy till with pockets of sand and gravel. Although large diameter wells tapping sandy till along streams or near lakes may yield as much as 100 gpm, there is a possibility that yields may decline with time, since these aquifers are generally of small areal extent.

Glacial till deposits composed of unsorted and unstratified mixtures of sand, silt, clay, and stones will generally have only small yields, and only a few wells will yield more than 10 gpm. This material is often relatively impermeable, and dug wells having large infiltration areas and large storage capacities are sometimes more successful than smaller diameter drilled or driven wells.

Another category of surficial deposit found in Dickinson County is swamp deposits. These deposits include peat and muck, and are generally confined to flat lowland areas alongside streams, lakes, or former lakes. Because these deposits sometimes overlie thick deposits of sand and gravel, large diameter wells may yield 100 gpm.

Ground water in Dickinson County is generally hard to very hard (150 to 250 ppm with a few wells and springs more than 300 ppm). The iron content of both glacial deposit and bedrock wells is quite variable, and ranges from less than 0.1 ppm to more than 4 ppm. Both hardness and excessive iron are amenable to treatment, and the quality of ground water in the County is otherwise generally suitable for household and most other uses.

In summary, the glacial deposits are the major source of ground water in Dickinson County, but the physical properties of these materials vary widely, and they exhibit specific capacities ranging from less than 1 to more than 300 gpm/ft. of drawdown. Because the surface of the underlying bedrock is highly irregular (especially within areas of Precambrian rock), the glacial deposits also vary in thickness from 1' to more than 150'. Wells in the County range from 1¼" to 60" in diameter and from 12' to more than 350' in depth, but most of the wells are 5" to 6" in diameter and 25' to 100' deep. The most favorable areas for large-scale ground water development are in sand and gravel deposits along major streams, while the least favorable areas are those in which Precambrian rocks crop out or are covered by only a thin mantling of glacial deposits.

Baraga County

Baraga County lies almost entirely within the Study Area. Water is obtained from both bedrock and glacial deposit aquifers. The glacial deposit aquifers are generally more productive, with yields ranging from 5 to 115 gpm and averaging about 30 gpm. Wells in the glacial deposits are generally less than 100' deep. The yield from the bedrock ranges from 1.5 to 50 gpm, with an average value of about 10 gpm.

In the northwest part of the County, most wells take their water from the Jacobsville sandstone bedrock and are from 100' to 500' deep. These wells generally penetrate 50 to 250 feet of sandstone. Wells deeper than about 200 feet may contain as much as 500 mg/l of chloride. The wells drilled in glacial deposits are shallower--perhaps no more than about 200' deep.

On the Abbaye Peninsula, both bedrock and glacial deposit wells are 100' to 200' deep, and may produce water having a high iron content. In northeastern Baraga County, a few wells obtain good quality water from glacial deposits although bedrock wells may produce water having a high chloride content. In the central portion of the County, there is very limited ground water development. Most household wells are in glacial deposits and are generally less than 100' deep. There are also some springs that yield water from glacial deposits. The wells tapping bedrock in this area are generally less than 100' deep and have only limited yields. In the south-central part of the County, conditions for ground water development appear to be unfavorable and very limited development has taken place.

In the Three Lakes resort area, most wells are less than 100' deep, and obtain water from the glacial deposits. Iron concentrations of over 5 mg/l are common in glacial deposit wells, although bedrock wells tend to produce water having a lower iron content.

There is a wide variation in water quality throughout the County. Shallow wells tapping the glacial materials tend to produce water having a low pH (acidic water). Most of the glacial deposit wells and a few of the bedrock wells have significant amounts of iron in their water, although iron content varies with well location.

Iron County

The eastern two-thirds of Iron County lies within the Study Area, and is underlain by hard and dense metamorphic and igneous Precambrian bedrock mantled by various types of glacial deposits. The wells tapping bedrock generally have low yields, with some wells yielding only about 1 gpm. Because fractures in the bedrock tend to become smaller and less numerous with depth, few wells are drilled more than 100' into the bedrock. The specific capacity of most wells drawing water from the bedrock is less than 1 gpm/ft. of drawdown. Most of the bedrock wells tend to have low iron content, although perhaps one-third of the wells have iron concentrations in excess of 0.3 ppm. The Precambrian rocks tend to yield moderately hard to hard water, and Doonan and Hendrickson (1967) state in their report that none of the samples tested from wells in the Precambrian were less than 60 ppm hardness.

Springs are not numerous in Iron County, and are found mainly in areas of moraines or till plain deposits. These springs typically yield only about 1 gpm, although springs emerging from outwash deposits near streams have been known to yield as much as 30 gpm.

Since bedrock within Iron County consists almost entirely of dense Precambrian rocks, the overlying glacial deposit which covers more than 90% of the area is the most important source of ground water. A variety of surficial deposits are present in the County.

Moraines are ice-deposited features formed along the edge of retreating glaciers and consist primarily of unsorted sand, gravel, silt, and clay, with occasional lenses of sand and gravel. Most of the wells tapping the morainal deposits are 5" to 6" in diameter and are generally less than 100' deep. They normally yield enough water for domestic supplies, although specific capacities of most wells are less than 1 gpm/ft. of drawdown. The depth to water in the moraine deposits ranges from 3' near streams or lakes to as much as 133' in wells located on hilltops. Water from the moraines is generally hard, with perhaps 75% of the wells falling in the moderately hard to hard category. The water also tends to have fairly high iron concentrations, with perhaps only about one-third of the wells having less than the recommended limit of 0.3 ppm.

Till plain deposits are another source of ground water and have small to moderate yields. Localized areas can sometimes be found which contain lenses and pockets of sand and gravel, in which case larger yields may be obtainable. Depth to water in wells tapping the till plain deposits ranges from about 9' in low-lying areas to about 100' or more on the hilltops. Most of the wells tend to have a specific capacity of more than 1 gpm/ft. of drawdown, although specific capacity values in this material may range from less than 0.1 to more than 30 gpm/ft. The till plain wells generally produce rather hard water, with more than half in the moderately hard to hard class and about one-fourth in the very hard class. The iron content tends to be low, with most wells producing water having less than 0.3 ppm iron concentration.

The outwash plains, although of limited areal extent, are the most favorable areas for obtaining large supplies of ground water. Large diameter wells located along stream valleys produce enough water for municipal or industrial supplies, and yields of several hundred gpm are possible in some areas. Most of the high production wells in the County are near major streams, and it is probable that many of these wells are obtaining recharge from the streams. The specific capacities in the wells tapping the outwash deposits range from 0.1 to 28 gpm/ft. of drawdown, and depth to water in areas along streams is generally low, the water is mostly moderately hard to hard, and some of the water from these wells is very hard.

There are also some areas of swamp deposits in Iron County. In places along stream valleys where these fine-grained deposits are underlain by coarse sand and gravel, large municipal or industrial water supplies could be developed.

In general, the total dissolved solids content of ground water in Iron County is probably less than about 500 ppm. Much of the water tends to be moderately hard to hard, so that softening is often necessary or desirable. About half the wells produce water having excessive (more than 0.3 ppm) iron, and iron removal is desirable. Some bacterial contamination from septic tank effluent may be present in some shallow aquifers in the southern part of the County. However, the water quality is generally satisfactory for most uses, and the iron and hardness problems can usually be solved by standard treatment methods.

To summarize, the main source of ground water in the County is the glacial deposits overlying the dense Precambrian bedrock. The most favorable areas for large-scale ground water development are outwash deposits located along major streams, while the least favorable areas are those in which bedrock crops out or has only a thin covering of glacial material. The most favorable areas for ground water development are in stream valleys or other low areas, although the thickness and composition of the glacial deposits present must be considered in addition to the topographic situation.

Houghton County

Only a very small part of east-central Houghton County lies within the Study Area. In this area, wells yielding up to about 50 gpm may be developed from the Jacobsville sandstone at depths ranging to about 500'. Water from depths of greater than 200' may be high in chloride.

Small yields may be expected from glacial deposits at depths probably less than 100'. The largest yields from surficial deposits can probably be expected from the alluvial deposits in the Sturgeon River valley. This Sturgeon River, which originates in Baraga County and flows generally west and then north before terminating in Portage Lake below Houghton City, is not to be confused with the Sturgeon River that originates near the Town of Sagola in Dickinson County and flows generally east and south through the Sturgeon River State Forest before emptying into the Menominee River below the Town of Vulcan.

RELATIONSHIP TO OTHER DATA

Depth to Water

Depth to water within the Study Area could prove to be of considerable importance in several respects. For construction operations involving large excavations, the depth to water could be of significance in the dewatering of excavation. Areas where water is near the surface could prove to be more difficult to dewater. Dewatering operations during construction excavation could conceivably cause a general lowering of the water table in the vicinity of any construction areas where large amounts of dewatering proved to be necessary. In some areas where mine dewatering has caused long-term lowering of the water table, flooding of basements has occurred due to rising water tables following cessation of pumping. A conceivable effect of a general lowering of the water table during construction would be a temporary decrease or perhaps even cessation in the yields of water wells located close to areas where large-scale dewatering operations were taking place. Large-scale ground water extractions carried out over a long period of time could conceivably cause some compaction of granular glacial deposits, with resulting land subsidence.

Quality of Water

The quality of ground water and the amounts and types of dissolved materials in the water could have several effects. Various factors operate to affect the quality of the ground water. Lithology is one important factor, and in the Study Area, the rock types present have a definite effect on the dissolved materials found in the ground water.

Waters of the Study Area tend to be rich in calcium, magnesium, and bicarbonate because many of the rocks (particularly limestones) are rich in these materials and as water moves through the rocks, it becomes a calcium-magnesium-bicarbonate type water having a high degree of hardness. The fact that the waters of this region are very hard is significant. If the water is to be used for water supply purposes, it would cause the formation of scale in piping, water heaters, or other equipment through which the water passes. The water will probably require some treatment to remove the hardness before it will be suitable for use in many types of equipment.

In connection with hardness problems, it should be mentioned that a high concentration of total dissolved solids and/or high values of specific conductance in the water may mean it will have corrosive properties, and this is particularly true if chloride is present in appreciable quantities. A corrosive water could conceivably cause problems with buried metallic elements if they are not adequately protected. This should not be a problem in the Study Area, since electrical conductance values of the ground water are not excessive--generally less than 800 microhms, while TDS values are usually below 500 ppm.

In addition to lithology, another factor affecting ground water quality is the rock-water contact time. If the water moves slowly through the rocks and is in contact with the rocks for long periods of time, then there is more opportunity for the water to dissolve material from the rocks through which it is passing. Intensity and type of land use can affect ground water quality, and excessive amounts of nitrate, phosphate, sulfate, and chloride may be indicative of pollution problems. In the Study Area, there is some indication of bacterial contamination of shallow aquifers, particularly limestones, due to surface pollution sources, but this problem is not widespread or serious.

If disposal of significant quantities of waste waters through the use of septic tanks and leach fields is required, degradation in ground water could occur. There is some evidence of water quality degradation in shallow aquifers due to septic tank effluent in some of the more highly populated parts of southern Iron County.

Several important constituents of the water in wells were examined, and excess quantities are shown by a coding system on the data map. As previously mentioned, high total dissolved solids content or specific conductance may imply that the water will cause corrosion problems. Also, the total dissolved solids content is a good general indication of the overall suitability of the water for a variety of uses; and waters having a high TDS may contain dissolved minerals causing the water to have a disagreeable taste or to be unsuitable in some other respect. In the Study Area, there are very few wells having a TDS concentration in excess of 1,000 mg/l, and many of the wells have values of less than 500 mg/l, so that high TDS values are generally not a problem.

Calcium and magnesium can be dissolved from practically all soils and rocks, but particularly limestone and dolomite, which are abundant in portions of the area. Calcium and magnesium are the cause of most of the hardness and scale-forming properties in water, and it may prove desirable or necessary to treat water which is excessively hard before it will be suitable for many uses to prevent scale formation in piping and other equipment. Sodium and potassium are also dissolved from almost all rocks and soils, and large amounts, in combination with chloride ion will cause the water to have a salty taste.

High bicarbonate levels in ground water can be caused by the action of dissolved carbon dioxide in water which is passing through carbonate-rich rocks such as limestones or dolomites. The diluted carbonic acid formed by the reaction of carbon dioxide and water dissolves the carbonate rocks, and a hard water, rich in calcium and magnesium bicarbonates is the result. The hard water will cause undersirable scale formation in piping and other equipment if it is not treated prior to use. Sulfate in ground water can be dissolved from rocks and soils which contain gypsum, iron sulfides, or other sulfur compounds. If calcium or magnesium are also present, the resulting calcium or magnesium sulfate may be one of the sources of hardness in the water. If sulfate is present in large amounts, it may impart a bitter taste to the water.

Because there are iron-bearing formations in parts of the Study Area, many of the wells produce water which has iron concentrations in excess of the recommended limit of 0.3 mg/l. As the ground water percolates through these iron-rich materials, iron is dissolved so that the ground water often contains significant quantities of iron. When this iron-rich ground water is pumped to the surface and exposed to the air, the iron oxidizes and produces a reddish brown sediment which causes staining problems in laundry, utensils, sinks, or other equipment in contact with the water. Iron-rich water may also have an unpleasant taste and will favor the growth of certain bacteria which utilize iron as part of their metabolism. These bacteria can form growths large enough to cause clogging of pipes, well screens, etc., so it is desirable to remove excessive iron to avoid these problems. Although many of the wells in the Study Area produce iron-rich water, standard treatment systems are generally effective in removing iron.

Chloride is dissolved from rocks and soils but is also present in sewage, and large amounts of chloride ions may be indicative of pollution problems. Large amounts of chloride will also increase the corrosiveness of water, and may give the water a disagreeable salty taste, especially if soidum is also present.

Nitrate in water may be caused by decaying organic matter, sewage, fertilizer, and nitrates in soil. It is not normally an important natural constituent of ground water, however, and high nitrate concentrations should be viewed as an indicator and a warning that pollution may be taking place, and that there is a possibility that harmful bacteria are present. Nitrate also encourages the growth of algae and other organisms which produce undesirable tastes and odors.

Aquifer Properties and Yields

One aquifer property of considerable importance is transmissibility, which is an indication of its ability to transmit water.

Although no values of transmissibility were available for the bedrock aquifers of the Study Area, it is probable that values in the Precambrian rocks are low. Some of the Paleozoic rocks bordering the Precambrian, however, probably have fairly high transmissibility values. Some of the glacial drift materials have high values of transmissibility, and pumping tests conducted in the Iron Range area of Marquette County indicated that glacial deposits in this area have transmissibility values ranging from 3,000 to as much as 150,000 gallons per day per foot (gpd/ft). Transmissibility is an important parameter in connection with such considerations as developing a ground water supply (high value of transmissibility desirable) or dewatering operations during construction (low value desirable).

Another important property of the aquifer is its porosity. The porosity is an indication of the void space within the aquifer and is an index of the aquifer's ability to store water. Although no porosity figures are given for the various aquifer units, it is probable that the Precambrian rocks have significantly lower porosity values than some of the younger Paleozoic rocks which border the Precambrian. The glacial drift materials which overlie both the Precambrian and Paleozoic bedrock in most of the Study Area generally have a higher porosity than the relatively dense Precambrian rocks. High porosity values and consequent large water storage potential would obviously be desirable from the viewpoint of developing a water supply, and undesirable when considering potential dewatering requirements.

Another property which is important is the specific capacity. This is an indication of the ability of the aquifer to supply water to a well, and large values would be desirable from a water-supply development viewpoint and undesirable from a dewatering viewpoint. Specific capacities in the Precambrian rocks are low, usually less than 1 gpm/ft.

Well yield data and specific capacity data are available on a fairly large number of wells in the Study Area. These data are tabulated in Appendix B. As can be seen from these data, while the dense Precambrian rocks generally have low yields and low specific capacities, the younger rocks such as the Paleozoic limestones and sandstones can have fairly high yields and specific capacities. In general, the highest yields and specific capacities are found in the glacial drift material, where yields can be several hundred gpm and specific capacity values of up to 70 gpm/ft.

The well yields from the Precambrian rocks are generally low, often less than 10 gpm. The most favorable areas for ground water development in the areas where Precambrian rocks are at, or near, the surface are generally the valleys where the bedrock may be more weathered and greater thicknesses of glacial overburden may be present. The Paleozoic sandstones and limestones generally have small to moderate yields, although yields from these rocks can be 200 to 300 gpm in some areas. Some of the glacial deposits, particularly outwash sands and gravels along major streams, can have high yields--as much as several hundred gpm.

VALIDITY

General Procedures

A bibliography of water-oriented data sources was compiled at the Michigan Technological University in Houghton, and was later expanded at the U. S. Geological Survey Library in Menlo Park, California, and the Stanford University Libraries. As publications were researched, additional data sources were found which were then added to the list.

A review of the data sources was made, and copies of valuable information were obtained. Visits were made and discussions were held with various individuals from universities, private companies, and both State and local government agencies in Michigan. A great deal of valuable information was obtained during these visits and discussions.

Pertinent information was abstracted from the various data sources and was synthesized into the drawings, tables, and text dealing with the subsurface water hydrology of the Study Area.

Data Sources

The primary source of data for ground water information in the Study Area was a series of reports, each usually dealing with a single county, which were done jointly by the USGS and the Geological Survey Division of the Michigan Department of Natural Resources. Reports were available for all eight counties of interest, although in the case of Marquette County, work is in progress, and the report has not yet been published. In Marquette County, the unpublished information was supplemented by USGS Water Supply Paper 1842, published in 1967. This report deals with both the surface water and ground water resources of the Marquette-Iron Range area in Marquette County. The County ground water reports are all fairly recent, the earliest (Delta County) being published in 1960.

These reports generally discussed items such as the bedrock and surficial geology and how they were related to the quantity and quality of ground water available. The various bedrock and glacial aquifers were described and discussed. Information on representative wells and springs was included, and in most cases, tabular data dealt with items of information such as well diameters, depths to water, depth of well, aquifer tapped, etc. Water quality data were also generally available, and some information on well yields and specific capacities was usually available in these reports. In general, the county reports gave a good summary of ground water conditions in the area.

Data Reliability/Limitations

The county ground water reports utilized as the major source of information for this study are considered to be generally up to date and reliable. These reports were usually based upon geologic data and records of water wells from the files of the Michigan Geological Survey, the U. S. Geological Survey, and from private well drilling companies. This information was supplemented by field inventory of selected wells and reconnaissance mapping of surficial formations in the field. All of the data were then used in the preparation of the county reports.

Although these reports do not give data on all wells existing in the various counties, discussions with USGS officials in Escanaba, Michigan, revealed that the reports typically include tabular data on approximately one-half of the well records on file at the time the report was written. The data selected for inclusion in each report were carefully examined to give a representative and accurate picture of ground water conditions and resources in the county. Because these reports did not include all data on file, and because additional wells have been drilled since the reports were published, there was some concern about whether the county reports needed to be supplemented by additional information on file with the USGS. This question was brought up in discussions with the Escanaba office of the USGS, and it was decided that the county ground water reports gave an accurate picture suitable for the present study and that the reports need not be supplemented.

With respect to locational reliability of the wells, the well location and identification system used in Michigan has been previously discussed, and this system allows the location of wells to within a 40 acre area, and measuring 1/4 mile by 1/4 mile on the ground. With respect to chemical analyses, the laboratory analyses are considered to be very accurate. In some instances, analyses have been performed in the field using a portable analysis kit, and the results are probably accurate to within ±10% to ±30%, depending upon the concentration and type of constituent being analyzed. Although five important cations and four important anions are included in the "excess ion" symbol shown on the map, it should be realized that in some cases, concentrations of some of these important ions have not been determined in the water analysis, so this represents a limitation on some of the water quality data appearing in the county ground water reports.

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APPENDIX A

RECORDS OF WELLS IN STUDY AREA

ALGER COUNTY

WELL RECORDS

Records of wells and test holes in Alger County

Aquifer: €j, Jacobsville Sandstone; €m, Munising Sandstone; O€u, rocks of Ordovician and Cambrian age, undifferentiated; Obr, Black River Limestone; Ot, Trenton Limestone; Qgd, glacial drift, undifferentiated; Qs, glacial sand; Qg, glacial gravel; Qsg, glacial sand and gravel.

Use: D, domestic; I, industrial; N, not used; O, observation well; P, public supply; T, test well.

Depth to Water: In feet below land surface; M, measured; R, reported.

Altitude: In feet above mean sea level, estimated from U. S. Geological Survey topographic maps.

Well Number	Location in Section ¼ ¼	Owner	Driller	Year Drilled	Diameter (in.)	Depth (ft.)	Aquifer	Use	Depth to Water	M or R	Date Measured	Altitude	Remarks
47N 22W													
5-1	SE SE	Tioga Tavern	-----------------	----	5	80	€j	P	-----	-	------	670	Bedrock near surface.
9-1	NW NE	Peter Arsenault	-----------------	----	--	80	€j	P	-----	-	------	---	------------------------
44N 22W													
5-1	SW NE	Mich. Hwy. Dept.	Wm. Nance	----	5	45	Obr	P	22	R	1956	995	Bedrock at 21 feet.
9-1	-----	--------------------	-----------------	----	--	398	--	T	-----	-	------	935	Test well for mineral.

BARAGA COUNTY

WELL AND SPRING RECORDS

WELL DATA

Township and Range	Section No.	Well No.	Location within Section 1/4	1/4	Well Depth (feet)	Well Diameter (inches)	Elevation of Ground Surface at Well (feet)	Water Bearing Unit	Yield (gal/min)	Specific Capacity (gpm/ft)	Depth to Water (feet)	Date of Measurement	Remarks
47N32W	25	1	NW	NW	6	36	1760	Gd			4	1969	Dug well, not used for drinking
	27	1	SE	NW	28	6	1760	—			32.6	9-21-69	Dry in 1965
47N34W	1	1	NW	SW	8	48	1695	Gd			7	1969	Abandoned hunting camp
	18	1	NE	NE		-	1640	Gd			—	—	Hunting Camp. Water temp. 7°C.
											-		
48N31W	17	1	NW	SW	70	7	1620	Br			3	1969	
	17	2	SW	NE	125	7	1620	Gd			—	—	
	17	3	SW	NE	20	1 1/4	1620	Gd			12	1947	
	21	1	NW	NE	97	4	1620	Gd			—	—	Beaufort Lake Campground
	33	1	SE	NW	55	6	1720	Gd			—	—	Equipped with Iron removal unit
	35	1	NW	SE	60	7	1700	Br			30	1968	
	35	2	NE	NE	98	7	1700	Gd			30	1968	Very soft water
	35	3	SE	SE	12	48	1685	Gd			9	1968	Rock outcrop 300 ft. North
48N32W	8	1	SW	NW	—	—	1640	—			—	—	Tioga Creek roadside Park
	13	1	NE	NE	30	7	1640	Gd			—	—	
	23	1	NE	NE	9	24	1700	Gd			8	1969	1 1/4 in. drop pipe inside [illegible]
	12	1	SE	SE	10	1 1/4	1635	Gd			8.74	10-1-69	obs. well measured by WMPCC.
48N33W	6	1	NE	NE	46	6	1560	Gd			—	—	Several undeveloped springs nearby
48N34W	17	2	NE	NE	55	—	1350	Gd			—	—	Pumped fine sand, water high in Iron
	18	1	[illegible]	[illegible]	50	6	1460	Br			—	—	Poor Yield
	18	2	SE	SW	150	6	1460	Br			—	—	Good Yield, supplements 18-1
	21	1	SW	NE	37	7	1540	Gd			5	1967	[illegible]
	21	2	NW	SE	40	5	1580	Gd			—	—	Water [illegible] high Iron [illegible]
	22	1	NE	SE	12	48	1600	Gd			12	—	Not used for drinking or [illegible]
	22	2	NE	SE	38	6	1600	Br			—	—	
	28	1	NE	SW	50	5	1610	Br			50	—	originally soft [illegible], poor yield. good yield at 50 ft [illegible]
	29	1	SW	SE	49	6	1550	Gd			—	—	
	31	1	SW	NE	66	6	1550	Br			—	—	

WELL DATA

Township and Range	Section No.	Well No.	Location within section ¼	¼	Well depth (feet)	Well diameter (inches)	Elevation of ground surface at well (feet)	Water bearing unit	Yield (gal/min)	Specific capacity (gpm/ft)	Depth to water (feet)	Date of measurement	Remarks
48N34W	32	1	SW	NW	63	1¼	1540	Gd			20	1968	
48N35W	34	1	NE	NE	33	5	1350	Br			12	1964	Perch R. Roadside Park
49N31W	28	1	SW	NE	19	7	1720	Gd			10.69	9-22-69	Leased by Mich. D.N.R.
49N32W	6	2	NW	SW	42	6	1680	Br			—	—	Will Pump 50 gal. then wait for recharge
49N33W	18	1	NE	SW	11	6	1290	Gd			9.09	10-15-69	obs. well in forest research
49N34W	14	1	SE	NE	139	6	1285	Gd			55	1956	Baraga Correction Camp
	28	1	NW	SW	22	2	1270	Gd			—	—	Big Lake Campground
50N31W	26	1	SE	NW	—	1¼	1800	Gd			—	—	Well inside locked hunting [illegible]
50N32W	18	1	NW	NW	22	2	1170	Gd			—	—	Laws Lake Campground, high Iron
50N33W	3	1	SW	SE	90	5	840	Gd			—	—	Water cloudy
	5	1	SE	NE	160	6	610	Br			+1	9-24-69	Flowing well at edge of football field
	10	1	NE	NW	120	4	860	Gd			12	1969	
	11	1	NE	NW	—	—	1000	Gd			—	—	Dug well, buried, High Iron, cloudy
	11	2	NW	NE	71	4	990	Br			—	—	Good yield, but high in Iron
	22	1	NW	NW	45	5	980	Br			—	—	Supplies residence, Store, 15 cottages
	28	2	SE	SE	30	5	1180	Br			—	—	pump 2½ gpm for 10 min by hand
50N34W	1	1	NE	NW	305	—	615	Pr			—	—	Insufficient yield for Baraga State Park supply
	1	1	NE	SE	200	5	800	Gd			—	—	Pumped 4 hrs, with gas powered pump
51N31W	4	1	SW	SW	72	7	620	Br			—	—	120 ft. well on same lot abandoned
	8	1	SE	SW	80	6	610	Br			12	1969	Water slightly cloudy
51N32W	8		SW	NE	279	5	620	Gd			5	1968	
	8	2	NE	SW	137	5	620	Gd			8	1968	
	9	1	NW	NW	266	5	640	Gd			14	1967	
	33	1	SW	NW	168	5	860	Br			35	1968	
51N33W	15	1	SW	SW	330	—	680	Br			—	—	
	28	1	SW	NW	155	5	825	Br			40	1967	well water contains 2.5 mg/l Iron
	28	2	NW	NW	118	5	790	Br			30	1968	Soft water

WELL DATA

Township and Range	Section No.	Well No.	Location within Section 1/4	Location within Section 1/4	Well Depth (feet)	Well Diameter (inches)	Elevation of Ground Surface at Well (feet)	Water Bearing Unit	Yield (gal/min)	Specific Capacity (gpm/ft)	Depth to Water (feet)	Date of Measurement	Remarks
51N33W	32	1	NE	NW	282	5	910	Gd			220	1968	
51N34W	9	1	SW	SW	227	6	660	Gd			9	1952	
	10	1	NE	NE	185	6	650	Br			5	1969	
	15	1	NE	NE	72	1¼	660	Gd			—	—	Hard water
	17	1	SW	SW	375	5	780	Br			50	1962	4 well 500 ft west, 425 ft deep
	20	1	NE	NE	216	6	680	Gd	200 gpm (1951)		Flowing		Flow supplies adequate pressure for house and barn
	21	1	SW	NE	315	5	660	Br			Flowing	1969	
	24	1	SW	SE	189	6	920	—			—	—	high iron
	24	2	NE	NW	15	48	940	Gd			—	—	water soft, high iron
	27	1	NW	SE	200	—	780	Br			—	—	water hard, high iron
	36	1	NE	NE	104	5	880	Gd			70	1967	
52N33W	16	1	SE	SW	151	6	720	Br			151	—	
	20	1	NE	SW	22	[illegible]	765	Gd			15	1969	Hard water
	28	1	SE	SW	220	6	860	Br			30	1966	
52N31W	26	1	SW	SW	26	—	720	Gd			18	1969	
	27	1	SE	NW	145	—	620	Br			—	—	
	27	2	NW	NW	—	6	610				—	—	Arvon Twp. Fork
	29	1	SW	SW	225	—	820	Br			—	—	Test pumped at 3 gpm
	32	1	NE	SE	82	5	620	Br			14	1967	Nearby well over 200 ft deep, abandoned
52N32W	33	1	NE	SE	167	—	610	Br			—	—	2nd Sand Beach [illegible]
	34	1	NE	SW	187	6	610	Br			4	1969	[illegible] 2nd well [illegible]
52N33W	2	1	SW	SW	164	6	650	Br			—	—	
	14	1	NW	NW	210	5	620	Br			17	[illegible]	
	14	2	NW	NW	210	5	620	Br			14	1968	
	14	3	NW	NW	229	4	620	Br			20	1968	[illegible]
	7	1	SW	SW	124	5	710	Br			[illegible]	1967	
	[illegible]	[illegible]	NW	NW	93	5	645	Br			Flowing	1967	
	29	1	SE	SW	19	60	700	Gd			16	1969	Soft water

WELL DATA

Township and Range	Section No.	Well No.	Location within Section 1/4	Location within Section 1/4	Well Depth (feet)	Well Diameter (inches)	Elevation of Ground Surface at Well (feet)	Water Bearing Unit	Yield (gal/min)	Specific Capacity (gpm/ft)	Depth to Water (feet)	Date of Measurement	Remarks
[illegible]2N32W	29	2	SE	SW	264	5	700	Br			13	1969	Soft water
	34	1	SE	NW	85	5	700	Br			—	—	
	34	2	SW	NE	157	5	630	Br			60	1967	

BARAGA COUNTY

RECORDS OF SPRINGS

Township	Range	Section	Location in Section	Date Samples	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Total Dissolved Solids	Hardness ($CaCO_3$)	Specific Conductance	pH	Temperature, °C	Estimated Yield, gpm
47N	31W	32	SE-NW	9-21-69	.50	—	11	0.5	0.3	55	35	85	5.8	8.5	10
48N	34W	17	NE-NE	9-19-69	0.10	166	12	10	1.7	214	139	330	7.7	8.0	2
49N	32W	6	SW-SW	9-22-69	1.3	140	9.0	3.0	1.3	155	122	245	7.9	14	—
49N	33W	18	SW-SE	9-10-69	0.50	—	8.0	18	1.6	—	85	220	6.9	—	—
50N	32W	18	SW-NE	9-22-69	2.2	107	12	1.0	0.3	114	85	200	7.3	8	2
50N	33W	28	SE-SW	9-20-69	0.30	—	15	15	2.7	159	114	250	6.9	8.5	2
51N	33W	25	NW-SE	8-12-69	0.50	32	1.0	8.5	0.1	65	50	115	5.9	12	3
52N	31W	19	SW-NW	8-13-69	<0.10	—	—	—	—	—	50	110	5.9	9.5	1
53N	31W	35	SW-SE	8-13-69	0.10	33	5.0	1.1	1.0	55	35	95	5.9	9.5	1

DELTA COUNTY

WELL RECORDS

Records of wells and test holes in Delta County

Use: D, domestic; S, stock; P, public supply; I, industrial; To, oil test; Ti, iron ore test; B, foundation boring; Tw, water test.

Water level: In feet below or above (+) land-surface datum; M, measured; R, reported.

Altitude: In feet above mean sea level (estimated from advance prints of U. S. Geological Survey topographic maps).

Well number	Location in section ¼ ¼	Owner	Driller	Year drilled	Depth (ft.)	Diameter (in.)	Aquifer	Use	Water level	M or R	Date	Altitude	Remarks
43N 23W													
4-1	SE NE	H. Hansen	-	-	12	48	Qgd	DS	7	M	10-24-58	1005	Abandoned.
5-1	SE SE	Mrs. Leech	-	-	16	60	Qgd	D	9	M	10-24-58	1020	
5-2	SW SW	Lathrop School	-	-	150	6	Otb	P	21	M	10-24-58	1040	Do.
6-1	NE SE	G. R. Stegath	-	-	85	6	Otb	D	-	-	-	1040	
6-2	NW NE	C and NW RR.	-	-	9	-	-	B	-	-	-	1051	Bedrock at 9 ft.
6-3	NE SE	Berthyl Hansen	Tom Rice and Son	1942	98	6	Otb	P	16	R	10-24-59	1040	
6-4	NW NW	David Williamson	D. Williamson	-	11	60	Qgd Otb	D	7	M	10-27-58	1055	Bedrock at 10 ft.
8-1	SE SW	C and NW Ry.	-	-	11	-	-	B	-	-	-	1008	Bedrock at 11 ft.
8-2	SW NW	do.	-	-	10	-	-	B	-	-	-	1024	Bedrock at 10 ft.
21-1	SW NE	John Niemi	Tom Rice and Son	1944	84	5	Otb	DS	-	-	-	980	
21-2	NW NW	J. C. Bartlett	Fred Rice	1956	40	-	Otb	D	-	-	-	980	
21-3	NW NW	do.	-	-	10	1½	Qgd	D	-	-	-	980	
24-1	NW NE	Toivo Lampi	-	1928	22	36	Qgd	D	-	-	-	940	Bedrock at 30 ft.
28-1	NW NE	C and NW Ry.	-	-	7	-	-	B	-	-	-	978	Bedrock at 7 ft.
28-2	NW SW	Victor Kallio	Tom Rice and Son	1943	30	5	Otb	DS	-	-	-	990	Bedrock at 10 ft.
28-3	SE SE	John Toyra	do.	1944	41	5	Otb	DS	-	-	-	975	Bedrock at 11 ft.
28-4	SW SE	Charles Valeen	do.	1943	102	5	Otb	DS	-	-	-	980	Bedrock at 12 ft.
32-1	NW SW	Sulo Auer	do.	1948	122	5	Otb	DS	-	-	-	980	Bedrock at 20 ft.
32-2	NW NW	Andrew Topala	do.	1943	84	5	Otb	DS	-	-	-	990	Bedrock at 9 ft.
34-1	SW NE	F. N. Mattila	do.	1940	365	4	Oat	DS	40	R	1940	960	
43N 22W													
5-1	SW SW	Erick Osterburg	-	-	7	60	Qgd	DS	3.4	M	10-24-58	950	Abandoned.
42N 23W													
4-1	SW NE	Edward Kaminen	Tom Rice and Son	1946	52	-	Otb	D	-	-	-	940	
5-1	NW NW	Aako Hamalainen	-	-	9	36	Qgd	D	5.5	M	10-29-58	970	

DICKINSON COUNTY

WELL RECORDS

Well Records

Explanation

Wells are identified according to their geographical township location, for example, "44N 30W 23-1 SE NE" refers to well #1 situated in the southeast quarter of the northeast quarter of section 23, of Township 44 North, Range 30 West.
Altitudes are estimated from topographic maps.

Pc .... Precambrian
Pa .... Paleozoic
Gd .... Glacial Drift

D .... Domestic
S .... Stock
P .... Public supply

I .... Industrial
O .... Observation

Well Number	Location in section ¼	¼	Owner	Driller	Date drilled	Diameter	Depth	Aquifer	Use	Water level	Date	Altitude	Depth to bedrock	Remarks
44N 30W														
23-1	SE	NE	Joe Dault	Anderson	1962	6	87	Pc	D	64	1962	1430	---	
23-2	SW	NE	Joe Dault	Kleiman	1957	6	69	Pc	P	22	3-15-57	1420	60	
23-3	NE	NE	E. J. DeGaynor	Kleiman	1958	6	79	Pc	D	13	6- 2-58	1420	68	
28-1	SE	NE	Dick. Co. 4-H Club	Anderson	1951	6	185	Pc	P	110	8-13-51	1420	170	Well abandoned because of excessive silt. Cased to 170 feet.
33-1	NE	NE	Bert Buckland	Kleiman	1962	3	71	Gd	D	32	7-16-62	1400	---	Cased to 68 feet.
44N 28W														
10-1	SE	SW	Casper Uldriks	Kleiman	1962	3	59	Gd	D	36.27	7-30-64	1280	---	
27-1	SE	SW	Ceasar Aimone	Owner	1934	60	13	Gd	D	11.16	9- 9-64	1260	---	
44N 27W														
17-1	NW	SW	J. McGreger	Kleiman	1956	6	43	Gd	D	22	6- 9-56	1240	---	
43N 30W														
9-1	SW	NW	O. Peterson	Anderson	----	5	28	Gd	D	18	----	1420	---	
9-2	NW	SE	Laurence Caray	Tucminen	1960	6	107	Pc	D	34	1960	1360	102	Cased to 102 feet.
11-1	NE	SW	Fred Janus	Kleiman	1963	6	68	Pc	D	41	6-13-63	1360	18	Cased to 20 feet.
29-1	NE	NE	F. Van Gilder	Anderson	1950	5	73	--	D	38	1950	1410	---	Cased to 66 feet.
29-2	SW	SE	Amos Dishaw	Glasr	1934	6	69	Pc	D	38	9-24-63	1480	40	
29-3	SE	SE	Sagola Township	--------	1923	6	115	Gd	P	------	----	1440	---	Supplies 50 families.
30-1	SW	SE	E. Johnson	Chiocchi	----	5	196	Pc	D	40	----	1530	40	Cased to 40 feet.
34-1	NW	SW	Edgar Erickson	Kleiman	1960	5	93	Gd	D	20	7-27-60	1360	---	
43N 29W														
36-1	NE	NW	--------	--------	1963 (?)	1¼	12	Gd	D	5.87	8-13-64	1180	---	
43N 28W														
23-1	NW	SE	Paul Mariucci	Chiocchi	----	5	42	Pa	D	15	----	1190	22	Cased to 22 feet.
23-2	NE	SW	John Cominsky	Kleiman	1959	5	60	Pa	D	31.19	3-18-64	1190	40	
23-3	NW	SW	Gilbert J. Johnson	Owner	1963	1¼	28	Gd	D	4	11-11-63	1140	---	
23-4	SE	SW	Norman Karstem	Kleiman	1961	3	49	Pa	D	44.47	8-24-64	1220	41	Cased to 45 feet.
23-5	SW	SE	--------	--------	----	1¼	14	Gd	D	8.74	7-30-64	1200	---	Well abandoned.
27-1	SE	NW	Sam Eutizzi	Chiocchi	----	5	62	Pa	D	30	----	1185	---	Cased to 22 feet.
43N 27W														
28-1	SE	SE	Joseph Turini	Kleiman	1963	3	47	Pc	D	8	1963	1160	42	Cased to 42 feet.
42N 30W														
2-1	SE	SE	Ron Koller	Kleiman	1964	4	30	Pc	D	18	2- 4-64	1320	13	Cased to 16 feet.
4-1	NE	SW	Donald Johnson	Kleiman	1961	5	42	Pc	D	35	4-27-61	1420	20	Cased to 25 feet.
7-1	SE	SW	Don Dario	Kleiman	----	4	59	Pc	D	49	1963	1410	45	
11-1	SW	NW	Norman Mainville	Kleiman	1963	6	70	Gd	D	28	6-14-63	1340	---	
18-1	NW	SW	John R. Williams	Kleiman	1961	6	32	Gd	D	------	----	1400	---	
18-2	SE	NW	Frank Mortell	Chiocchi	----	5	159	Pc	D	------	----	1410	140	
18-3	NE	NW	Leo Hart	Kleiman	1964	4	92	Gd	D	67	3-12-64	1390	---	
24-1	NW	NE	Paul Richards	Kleiman	1959	5	39	Pc	D	9.31	10-16-64	1320	38	
26-1	SE	NE	Herbert Locarelli	Kleiman	1958	6	36	Pc	D	23	9-24-58	1260	20	
28-1	SE	SE	Elmer Schowalder	Chiocchi	----	5	203	Pa	D,S	40	----	1260	---	
32-1	NE	SE	Clayton Rush	Kleiman	1957	6	133	Gd	D	70	7-25-57	1260	---	
33-1	NE	SE	John Horvath	Chiocchi	----	5	105	Pc	P	------	----	1260	---	Cased to 40 feet.
33-2	NE	SE	Harry Horvath	Chiocchi	----	5	72	Pc	D	20	10-15-64	1260	---	Cased to 30 feet.
42N 29W														
22-1	NE	SE	August Zamboni	Owner	----	24	24	Gd	D	21	10-14-64	1120	---	Dug well.
22-2	NE	SE	Watson	--------	----	4	39	--	D	flows	10-14-64	1130	---	
22-3	NE	SE	Joe Lajennesse	Kleiman	----	4	28	Gd	D	5	10-15-63	1130	---	
26-1	SE	SE	Carlton Cook	Kleiman	1961	6	57	Pc	D	6	5-29-61	1220	45	
30-1	NW	SE	M. A. Hanna Co.	Layne NW	1957	12	85	Gd	O	20.05	11-18-64	1260	---	
31-1	NE	SE	M. A. Hanna Co.	Layne NW	1951	12	128	Pa	D?	54	4- 2-51	1360	15	Used as domestic supply in iron ore plant.
32-1	SE	NE	Roy Leonard	Kleiman	1958	6	38	Pa	D	23.67	3-19-64	1260	18	
32-2	NW	SW	M. A. Hanna Co.	Layne NW	1958	10	161	Pc	O	16.01	11-18-64	1320	10	
33-1	NW	SE	Elnor Helander	T. Rice	1943	4	85	--	D	------	----	1240	---	Had unpleasant taste 1963.
34-1	SW	NE	Fabian Steinbrecker	Kleiman	1958	6	82	Pc	D	39	8-12-58	1240	18	
34-2	SE	SE	Ronald Bergstrom	Kleiman	1960	6	101	Pc	D	61	4-13-60	1160	52	
42N 28W														
5-1	SE	NW	Kenneth Sheldon	Kleiman	1956	6	55	Pa	D	38	9-22-56	1160	15	
5-2	NE	SE	Edward Lantz	Chiocchi	----	5	96	Pa	D	42	----	1200	---	Cased to 32 feet.
5-3	NE	NW	Oliver Jedvick	Chiocchi	----	5	205	Pc	D	52	----	1160	---	Cased to 175 feet.
5-4	NW	NE	--------	Owner	1964	1¼	22	Gd	D	7.06	9-11-64	1160	---	
5-5	NE	SE	Roy Lantz	Chiocchi	1964	6	60	Pa	D	30	10-23-64	1180	---	
20-1	NE	SW	Rudy Gustafson	Owner	1964	5	67	Gd	D	30	9-11-64	1140	---	Pumps fine silty sand.
29-1	NW	NE	Clark Lucas	Chiocchi	1964	5	94	Pc	D	35	9-11-64	1180	---	
35-1	SE	NE	Edwin Osan	Kleiman	1958	6	50	Gd	D	13	4-17-58	1120	---	

Well Number	Location in section ¼	¼	Owner	Driller	Date drilled	Diameter	Depth	Aquifer	Use	Water level	Date	Altitude	Depth to bedrock	Remarks
42N 27W														
20-1	NE	NW	Joe Trepanier	Chiocchi	----	5	60	Pa	D	21.92	9-14-64	1200	---	Cased to 25 feet.
26-1	SW	NW	J. B. Erickson	Kleiman	1956	6	68	Gd	D	4	10- 2-56	1100	---	
29-1	NW	SE	Sanford Olson	Chiocchi	----	5	72	Pa	D	44	----	1080	---	
32-1	SE	NW	Wm. Dave	Chiocchi	----	5	76	Pa	D	50	----	1130	---	Cased to 32 feet.
32-2	SW	SW	S. J. Peterson	Chiocchi	----	5	138	Pc	D	40	----	1120	---	Cased to 40 feet.
33-1	NE	NW	E. W. LaFreniere	--------	----	36	12	Gd	O	11.19	3-17-64	1060	---	WMP obs. well #10.
41N 30W														
3-1	NE	SW	Duane Pollack	Kleiman	1960	6	78	Gd	D	13	8-24-60	1260	78	Gravel 70 to 77 feet.
4-1	NE	SW	E. J. Verrette	Kleiman	1958	6	80	Pc	D	39	3- 4-58	1300	75	Rock bluff 100' South.
16-1	NW	NE	Herman Bremer	Kleiman	1958	6	40	Gd	D	4	6-19-58	1200	---	Rock bluff 100' West.
17-1	NE	NE	Ellen Sjoquist	Kleiman	1958	6	30	Gd	D	24	7-31-58	1260	---	
25-1	NE	SW	Dick. Co. Rd. Comm.	WMP Co.	1948	1¼	20	Gd	O	dry	11-19-64	1220	---	Contains water in spring.
25-2	SE	NE	Oscar Martinson	Owner	----	48	12	Gd	O	11.42	12- 2-63	1200	---	WMP Co. obs. well.
25-3	SE	NE	Oscar Martinson	Anderson	1949	6	54	--	D	33	9-49	1200	---	
25-4	NW	SE	William Carolla	--------	----	6	60	--	D	------	----	1240	---	
25-5	SE	NW	Mel Martin	Kleiman	1955	6	120	Pc	D	14	7- 7-55	1260	63	
27-1	NW	SE	John Colombo	Kleiman	1958	6	104	Gd	D	------	----	1200	---	Pulled casing back to 51 ft.
27-2	SE	SW	Darwin Wilson	Chiocchi	----	5	49	Gd	D	30	----	1190	---	
28-1	SE	SE	Merriman Comm. Bldg.	Anderson	1957	6	70	--	P	37	1957	1170	---	Screen finish.
30-1	NE	NW	Maitland Dow	Anderson	----	6	63	--	D	15	----	1180	---	
32-1	SE	NE	Norm LaFarve	Kleiman	1964	7	150	Pc	D	18	5-20-64	1240	50	Cased to 54 feet.
34-1	SE	SW	Elerde Falus	Anderson	----	6	128	--	D	85	----	1270	---	Screen finish.
41N 28W														
1-1	SE	SE	Carl Johnson	Chiocchi	----	6	240	Pc	D	72	----	1160	---	Cased to 72 feet.
8-1	SE	SW	John L. Peterson	Chiocchi	1953	4	42	Pa	D	16	1953	1150	8	
12-1	SE	NE	Harry Peterson	C. Rice	1930	4½	197	Pa?	D	50	3- 3-61	1040	---	
34-1	NW	SW	Marlin & Griffee	Owners	1961	1¼	13	Gd	D	8.72	11-13-64	990	5	Pipe in fracture in bedrock.
41N 27W														
2-1	NE	NW	A. Francke	Anderson	----	6	40	Gd?	D	34	----	1180	---	
6-1	SE	SE	Allen Johnson	Chiocchi	----	5	105	--	D	8	----	1170	---	Cased to 88 feet.
7-1	NE	NE	Pat Milligan, Jr.	Chiocchi	1959	5	109	Pc	D	67	1959	1180	---	Cased to 67 feet.
7-2	SW	NW	Pat Milligan	Chiocchi	1963	5	72	Pc	D	22	1963	1060	---	Cased to 22 feet. Open finish.
7-3	NW	SE	Foster City Cemetery	T. Rice	1948	6	55	--	P	------	----	1060	---	
7-4	SW	SW	Reuben Skogman	Chiocchi	----	5	96	Pa	D	64	----	1150	---	On top of bluff. Cased to 10 feet.
9-1	SE	NW	Dale Siglar	Chiocchi	----	6	90	Pa	D	10	----	1040	---	Water contains 2.0 ppm iron.
40N 31W														
23-1	SE	SE	Pine Mt. Corp.	Rometti	1961	6	116	Pa	I	50.72	9- 5-61	1165	32	
23-2	SE	SE	Pine Mt. Corp.	Rometti	1961	6	150	Pa	I	------	----	1165	32	
23-3	SE	SE	Pine Mt. Corp.	Rometti	1961	6	125	Pa	I	------	----	1170	32+	Cased to 34 feet.
40N 30W														
5-1	SW	NW	John DeGrave	Anderson	1957	5	88	Gd?	D	67	1957	1200	---	
6-1	SE	SW	Joseph Giachino	Rometti	1963	6	31	Gd	D	10	1963	1200	---	Screen finish.
6-2	SE	SE	Joseph Langford	Kleiman	1958	6	82	Gd	D	------	----	1180	---	
8-1	SW	NW	Wes Fontenhio	Kleiman	1963	4	36	Gd	D	16	7-63	1120	---	
14-1	SE	SW	Dave Heidke	Anderson	1962	6	110	Pc ?	D	78	9-62	1100	110	
14-2	SW	SE	Wm. Haigh	Anderson	1964	6	110	--	D	72	1964	1100	---	Cased to 90 feet.
17-1	SE	NE	Immanuel Baptist Church	Kleiman	1962	3	19	Gd	P	6	6-16-62	1180	---	
18-1	SE	SW	Jerry Miksa	Kleiman	1959	6	78	Gd	D	17	6-13-59	1140	---	
18-2	SE	SW	H. B. Miller	Kleiman	1959	6	79	Gd	D	39	10-21-59	1140	---	
18-3	SE	SW	M. Tousignant	Kleiman	1956	6	64	Gd	D	29	----	1140	---	
18-4	NE	SW	F. Hermance	Kleiman	1958	6	71	Gd	P	34	10- 3-58	1160	---	
18-5	NE	SW	Otto Kelberg	Kleiman	1960	6	83	Gd	P	27	5-19-60	1180	---	
18-6	NW	NW	Charles Lindberg	Kleiman	1955	6	20	Gd	D	4	8-21-55	1160	---	
18-7	NE	NW	Ervin Swolinski	Kleiman	1960	6	41	Gd	D	4	11-28-60	1180	---	
19-1	NE	NW	Reuben Hamari	Kleiman	1959	6	81	Gd	D	35	9-26-59	1140	---	
19-2	NW	NE	Bacco Const. Co.	Kleiman	1958	6	48	Gd	D	21	7- 1-58	1160	---	
19-3	SE	NE	Esau Cohodes	Kleiman	1958	6	52	Gd	D	12	9-24-58	1140	---	
20-1	SE	NE	City of Iron Mountain	--------	----	2	---	--	P	Flows	9-17-64	1160	---	Flows 20 ft. above lake
21-1	SE	SW	Dickinson County	Kleiman	1957	6	30	Gd	D	4	11-15-57	1160		
23-1	NE	NE	John Pengrazi	Kleiman	1963	4½	60	Pc	D	14	11-63	1100	---	Cased to 29 feet.
23-2	NE	SE	Eugene Bronz	Kleiman	1962	6	107	Pa	D	5	4-62	1180	100	Cased to 102 feet.
24-1	NE	SW	John Fontecchio	Kleiman	1963	6	46	Gd	D	26	10- 1-63	1140	---	
27-1	NE	SW	Allan Carlson	Kleiman	1959	6	75	Gd	D	26	4-20-59	1150	---	Occasionally shows slight red color.
27-2	SW	NW	F. Pesavento	Kleiman	1959	6	65	Gd	D	36	4-16-59	1180	---	
27-3	SW	SW	Richard Waldbillig	Kleiman	1955	6	64	Gd	D	28	10-20-55	1160	---	
28-1	SW	NW	Jane Thekan	Kleiman	1962	6	49	Gd	D	5	4-26-62	1160	---	Water silty if pumped at more than 30 gpm.
31-1	SW	NW	Zacks Fruit Co.	Kleiman	1958	6	70	Gd	I	14	----	1140	---	
40N 29W														
6-1	SW	NW	Mich. Dept. Cons.	Kleiman	1964	4	30	Gd	-	17.97	9- 8-64	1120	27	Insufficient water to develop well. Casing pulled.
6-2	NW	SW	Mich. Dept. Cons.	Kleiman	1964	4	37	Gd	-	12.22	9-11-64	1120	37	Screen plugged with silt. Casing pulled.
28-1	NE	NW	George Branback	Kleiman	1962	3	30	Gd	D	19	9-11-62	1160	---	
28-2	SW	NE	Howard Hamill	Kleiman	1961	3	21	Pc	-	dry	10-30-61	1140	21	
29-1	SW	SW	Stanish Bal	Anderson	1961	6	52	Pc ?	S	2	1961	1100	---	Cased to 18 feet.
31-1	SW	SE	Joe Baciak	Anderson	1963	6	200	Pa	D	40	1963	1100	68	Cased to 68 feet.
40N 28W														
4-1	NE	SE	C. M. Huck	Anderson	----	5	52	Gd?	D	36	----	1000	---	
4-2	NW	SW	Anton Stockovitz	Anderson	----	6	80	Pc ?	D	35	----	990	---	Cased to 38 feet.
10-1	NE	SW	Clyde Randall	Chiocchi	----	5	96	Pc	D	32	----	990	---	Cased to 35 feet.
12-1	NW	NW	Wm. Asselin	Kleiman	1960	5	157	Gd	D	19	10-21-60	980	60	Cased to 60 feet. Casing dynamited at 41 ft. to provide additional supply

Well Number	Location in section ¼	¼	Owner	Driller	Date drilled	Diameter	Depth	Aquifer	Use	Water level	Date	Altitude	Depth to bedrock	Remarks
40N 28W (Cont'd)														
26-1	NE	SE	N. Cousineau	Kleiman	1963	3	70	Gd	D	19	5-10-63	980	---	
35-1	SW	NE	Bernard Rossato	Kleiman	1961	3	57	Gd	D	46	7- 3-61	1000	---	
39N 31W														
12-1	NE	SE	Wis. Mich. Power Co.	Anderson	----	6	345	--	-	8	----	1100	---	Open finish
12-2	NE	SE	Wis. Mich. Power Co.	Anderson	----	8	72	--	-	45	----	1100	---	Screen finish
39N 30W														
1-1	SW	NW	Glenn Anderson	Anderson	----	6	100	Pc	D	16	----	1060	30	
1-2	SW	SW	Alfred Oelke	Chiocchi	----	5	327	Pc	-	75	----	1060	---	Cased to 73 feet.
2-1	NW	SW	Louis Chiocchi	Chiocchi	1963	6	228	Pc	D	40	1963	1040	37	Cased to 37 feet.
3-1	SE	NE	Breitung Township	--------	1942	20	125	Gd	P	------	----	1040	---	Gravel pack finish.
3-2	SE	NE	Breitung Township	Layne NW	1953	8	160	Gd	P	60	4-53	1040	---	Screen finish.
4-1	NW	NE	Guy Gustaffson	Anderson	1960	6	35	Pc	P	28	4-61	1050	---	
8-1		NW	Wis. Mich. Power Co.	Anderson	1959	6	92	Pa	D	55	----	1000	---	Screen finish.
13-1	Center		Kimberly-Clark Corp.	Kleiman	1956	6	140	Gd	O	132.75	10-28-64	1051	---	
13-2	NW	SW	Kimberly-Clark Corp.	Kleiman	1957	6	118	Gd	O	111.52	10-28-64	1041	---	
13-3	SW	NW	Kimberly-Clark Corp.	Kleiman	1956	6	50	Gd	O	dry	3- 7-56	1052	50	
13-4	NE	NW	Wallace Jones	Chiocchi	----	5	114	Gd	D	92	----	1040	---	
14-1	Center		Kimberly-Clark Corp.	Kleiman	1956	6	95	Gd	O	78.41	10-28-64	1025	95	Gravel packed screen finish.
14-2	Center		Kimberly-Clark Corp.	Kleiman	1957	6	30	Gd	O	12.68	10-28-64	960	---	Water level fluctuates with river.
39N 29W														
2-1	SW	NE	Wm. LaVoie	Anderson	1946	5	72	Gd	D	36	9-64	980	---	
5-1		SE	Ame-ico Tinti	Anderson	1949	6	174	--	D	75	1949	1040	---	Cased to 68 ft. Open finish.
8-1	NE	SE	James Stewart	Kleiman	1958	6	112	Gd	I	56	6- 5-58	940	---	Water contains excessive ferric iron.
12-1	SW	SW	Stan Baciak	Chiocchi	----	6	168	Pa	D	40	1963	1040	---	Open finish.
14-1	NW	SW	Frances Girardi	Chiocchi	----	5	47	Gd	D	20	9-15-64	860	---	
14-2	SW	SW	R. Haferkorn	Owner	----	36	21	Gd	S	12	1964	850	---	
15-1	SE	SE	Joseph Haferkorn	Chiocchi	----	5	158	Gd	D	45	9-64	840	---	Slight taste.
17-1	SE	NE	Lewis Rector	Kleiman	1958	6	140	Pc	D	------	----	940	50	
20-1	NW	NE	Joe Palluch	Chiocchi	1961	6	40	Gd	D	15	----	----	---	
22-1	SW	SE	Mike Mannicor	Kleiman	1963	4	88	Gd	D	28	10-30-63	860	---	
25-1	NE	NE	Francis Sweig	Kleiman	1962	3	70	Gd	D	3	6-16-62	860	---	
26-1	NE	SE	Adam Ball	Chiocchi	1959	5	349	Pc	D	60	----	----	80	
27-1	NE	SE	City of Norway	Kleiman	1958	6	40	Gd	D	10	11-26-58	----	---	Supplies 3 houses.
36-1	SE	NE	Henry Varda	Kleiman	1963	7	101	Pc	D	42	10-63	----	100	
39N 28W														
7-1	SW	SW	Murriel Girard	Chiocchi	----	5	268	Pc	D	60	----	880	62	Cased to 62 feet.
7-2	SW	SW	Joe Drie	Kleiman	----	5	69	Gd	D	15	----	880	---	
8-1	SE	NE	Wis. Mich. Power Co.	Anderson	1962	6	87	Pc	P	21.06	9-15-64	900	37	
14-1	NW	NW	Paul Hupp	Anderson	1959	6	39	Gd	D	25	1959	970	---	Screen finish.
14-2	SW	SE	Robert Bunt	Glass	1962	6	167	Pc ?	D	90	6- 3-61	1060	87	
16-1	NW	NW	Steve Bubloni	Anderson	1963	6	150	Pc	D	72.57	9-15-64	1040	72	Cased to 100 feet.
16-2	SW	SE	Frank Habamer	Anderson	----	6	42	Gd	D	18	----	1060	---	
18-1	NW	NW	Kaspinski Tavern	Anderson	1961	6	72	Gd?	P	51	9-61	900	---	Cased to bottom.
19-1	SW	SW	Leonard Losito	Kleiman	1962	3	27	Pc	D	3	6-16-62	850	16	
19-2	SW	SW	Sue McCormick	Kleiman	1961	3	45	Pc	D	------	----	850	42	
19-3	NW	NW	Walter Breclaw	Chiocchi	----	5	275	Pc	D	76.42	5-14-64	860	---	Cased to 74 feet.
20-1	SW	SE	George DeRidder	Kleiman	1962	3	40	Gd	D	24	6-20-62	860	---	
20-2	SE	SE	Ed. Bouchey	Kleiman	1963	3	120	Gd	D	6	4-30-63	860	---	
21-1	NW	SW	Clifford Frenn	Chiocchi	----	5	196	Pc	D	85	----	----	---	Cased to 96 feet.
24-1	SW	SE	C. Linder	Le Beau	1963	5	100	Pa	D	77.28	9-15-64	1020	---	Open finish.
25-1	NW	NE	Richard Skog	Anderson	1948	6	88	--	D	61	1948	1000	---	Cased to 73 feet.
30-1	NW	NE	Frank Bray	Kleiman	1962	3	18	Gd	D	7	6-10-62	860	---	
30-2	NW	NE	Ernest Cosanova	Kleiman	1961	3	18	Gd	D	flow	6- 9-61	860	---	Flowed 0.5 ft. above land surface 6-9-61
30-3	SW	NE	Mary Johnson	Kleiman	1962	3	34	Pc	D	17	6- 7-62	860	23	Cased to 24 feet.
30-4	SW	NE	Lee Johnson	Kleiman	1962	3	27	Gd	D	flow	6- 2-62	840	---	Flowed 5 gpm 3 ft. above land surface 6-2-62
30-5	SE	NW	Harry Teafoe	Chiocchi	----	5	368	Pc	D	28	----	----	---	Cased to 35 feet.
30-6	SW	NW	Dickinson Co. Park	Chiocchi	----	5	91	Gd	P	47	----	----	---	
30-7	SW	NE	Carroll Asp	Chiocchi	----	5	58	Pc	D	22	----	----	---	Cased to 38 feet.
30-8	SE	NW	Carl Danelison	Chiocchi	1953	5	57	Pc	D	14	----	----	---	Cased to 20 feet.
32-1	SW	SW	Julius Van Wiele	Owner	1950	6	132	Gd	S	20	1950	----	132	Pulled casing back 0.5 ft. into gravel
35-1	NW	NW	Ed Hag[illegible]son	Le Beau	1947	6	120	Pa	D	55	1947	----	96	Cased to 96 feet.

IRON COUNTY

WELL RECORDS

Records of Wells

Aquifer: Pcr - Precambrian rocks; Pz - Paleozoic rocks; Gd - Glacial drift

Use: D - Domestic; S - Stock; P - Public Supply; I - Industrial;
O - Observation; T - Test Hole

WMP - Wisconsin-Michigan Power Company

Water level is in feet below land surface.

Well number	Location in section	Owner	Driller	Date drilled	Diameter	Depth	Aquifer	Use	Water level	Date	Altitude	Depth to bedrock	Remarks
41N 31W 10-1	SW NE	Iron Co. Rd..Comm.	WMP	----	1¼	17	Gd	O	14.53	11-1-65	----	---	WMP obs. well
14-1	SE NW	Dick Abraham	Kleiman	1961	3	106	Pcr	D	78	1961	1300	104	Water very cloudy
14-2	SW NE	C.J. Carlson	Rommetti	1959	6	103	Gd	D	68	1959	1300	103	Will supply comm. nursery by 1966
41N 32W 11-1	SE SE	George Gruell	Kleiman	1963	6	42	Gd	D	22	1963	1240	---	
42N 31W 6-1	SW SE	Leonard Olsen	Tuominen	1964	5	40	Gd	D	25	1964	1320	---	
6-2	NW NW	Mich. Dept. Cons.	Owner	1965	2	32	Gd	P	26	1965	1360	---	Glidden L. Camp-ground
33-1	NW SE	Iron Co. Rd. Comm.	WMP	1954	1¼	10	Gd	O	2.39	11-1-65	----	---	WMP obs. well
33-2	NW SE	J. Giachino	---	----	15	12	Gd	D	9.55	11-1-65	----	---	WMP obs. well
42N 32W 15-1	NW SE	E. Brauer	Tuominen	1965	5	86	Gd	D	22	1965	1310	---	
26-1	SE NW	Iron Co. Airport	Kleiman	1960	6	110	Gd	P	40	1960	1340	---	
29-1	NW NW	Mrs. Gursky	Tuominen	1961	5	90	Pcr	D	21.19	7-30-65	1400	52	Open casing, never used
42N 33W 1-1	NW NE	Mastadon Twp.	Owner	1958	8'X 12'	20	Pcr	P	7.76	7-16-65	1485	9	Equipped with chlorinator
1-2	SW NE	Mastadon Twp.	Wilcox	1954	6	100	Pcr	P	30	1954	----	5	Abandoned, replaced by 1-1
12-1	SE SE	Village of Alpha	Layne N.W.	1930	16	43	Gd	P	-----	----	1400	---	Gravel pack
13-1	NE NE	Village of Alpha	Layne N.W.	1930	16	41	Gd	P	-----	----	1390	---	Gravel pack, stand by unit
13-2	NE NE	E. Kascielski	Tuominen	1960	5	90	Gd	P	3.09	8-11-65	1400	---	
15-1	SE NW	Wm. Jutila	Tuominen	1964	5	200	Pcr	D	43	1964	1435	156	
15-2	NE SE	J. Romanowski	Tuominen	----	5	43	Gd	D	29	----	1380	---	
28-1	SE SW	J. A. Gondek	Kleiman	1959	6	68	Gd	D	28	1959	1330	---	Dynamited boulders at 18'
42N 34W 9-1	SW NW	Village of Gaastra	Layne N.W.	1945	---	150	Gd	P	86.88	7-21-65	1620	---	Gravel pack
13-1	SE NW	Stambaugh Twp.	Layne N.W.	1956	12	61	Gd	P	35.98	5-13-65	1450	---	Gravel pack
25-1	SE SE	Stambaugh Twp.	Tuominen	1964	6	88	Gd	P	41	1964	1400	---	
25-2	SE SE	R. Mathison	Tuominen	1961	5	99	Gd	D	30	1961	1395	---	
42N 35W 1-1	SW NW	City of Caspian	---	1927	10	60	Gd	P	-----	----	1480	---	Dug well 30'x 30' to 52' deep; two 10" casings to 60'. Used as standby unit.
1-2	SW NW	City of Caspian	Layne N.W.	1957	18	65	Gd	P	21.71	5-12-65	1480	---	Gravel pack
11-1	NW SE	Stambaugh Twp.	Layne N.W.	----	12	58	Gd	P	17.01	5-13-65	1615	---	
20-1	NE NE	Brule Mtn. Ski Area	Kleiman	1964	6	32	Gd	I	12	1964	1540	32?	Used for snow machine. Has been pumped @ 100 gpm.
20-2	NE NE	Brule Mtn. Ski Area	Wilcox & Audio	----	6	25	Gd	P	-----	----	1540	25?	During ski season pump runs constantly.

Records of Wells.--Continued

Well number	Location in section	Owner	Driller	Date drilled	Diameter	Depth	Aquifer	Use	Water level	Date	Altitude	Depth to bedrock	Remarks
43N 31W 4-1	SE SW	Jack Sophie	Kleiman	1963	6	51	Pcr	P	14	1963	1390	15	Cased to 29'
16-1	SW NE	Ray Peterson	Kleiman	1963-	6	95	Pcr	D	23	1963	1420	---	Cased to 20'
24-1	NW NE	P. Mitchell	Kleiman	1963	4	59	Pcr	D	9	1963	----	39	
26-1	SE NE	Francis Drake	Kleiman	1963	4	30	Gd	D	18	1963	1400	---	Screen plugs with silt
33-1	NE SE	Mansfield Twp.	Kleiman	1963	3	31	Gd	P	5	1963	1320	---	Dawson L. Park
35-1	NE NW	Mansfield Twp.	Kleiman	1961	5	50	Gd	P	15	1961	1380	---	Twp. hall
36-1	SE NW	Robt. Magray	Tuominen	1961	5	70	Pcr	D	12	1961	1420	38	
36-2	NW NW	Alex Mac Leod	Tuominen	1964	5	75	Pcr	D	21	1964	1405	71	1.5 ppm Fe
43N 32W 1-1	NW SW	Stock	---	----	4	---	Gd?	D	-----	----	1375	---	Hunting camp
4-1	NW SE	Minarcik & Janov	---	----	1¼	51	Gd	D	41.26	8-17-65	1490	---	
4-2	NE SW	Paros	---	----	6	37?	Gd?	D	23.69	8-17-65	1490	---	More than 4 ppm iron
6-1	NW SW	James Whittock	Tuominen	----	5	68	Gd	D	13	----	1380	---	
21-1	SE NW	City of Crystal Falls	Odgers	1929	10	90	Gd	P	22.87	5-10-65	1355	---	City well #1
21-2	SE NW	City of Crystal Falls	Odgers	1929	10	90	Gd	P	-----	----	1355	---	City well #2
21-3	SE NW	City of Crystal Falls	Odgers	1929	10	85	Gd	P	-----	----	1355	---	City well #3
21-4	SE NW	City of Crystal Falls	Layne N.W.	1961	2	50	Gd	O	1.14	5-10-65	1355	---	Test hole
21-5	SE NW	City of Crystal Falls	Layne N.W.	1961	2	69	Gd	O	8.07	5-10-65	1355	---	Test hole
21-7	SE NW	City of Crystal Falls	Layne N.W.	1963	10	91	Gd	T	1	1963	----	92	Insufficient water, pipe pulled
28-1	NE NE	City of Crystal Falls	Layne N.W.	1961	--	102	Gd	T	-----	----	----	---	TH -pipe pulled
28-2	NE NE	City of Crystal Falls	Layne N.W.	1961	--	90	Gd	T	-----	----	----	---	TH -pipe pulled
28-3	NE NE	City of Crystal Falls	Layne N.W.	'1956	8	90	Gd	T	-----	----	----	---	Insufficient H_2O; pipe pulled
29-1	SE NE	City of Crystal Falls	---	----	--	---	Pcr	P	+4.0	9-24-65	1360	---	Old diamond drill hole, has flowed many years
43N 33W 14-1	SW SE	Crystal Falls Twp.	Layne N.W.	1950	10	55	Gd	P	21.22	5-10-65	1400	---	Lind well, gravel pack
21-1	SE SW	Wm. Honkala	Kleiman	1961	6	145	Gd	D	125	1961	1540	---	
27-2	SW NW	E. Reiman	Pickands-Mather	1950	3	53	Pcr	P	20	1950	1400	20	Drilled as iron ore Test hole
27-3	SW NW	E. Reiman	Pickands-Mather	1950	3	500+	Pcr	D	20	1950	1400	20	Do.
31-1	SE SW	F. G. Pardee	Layne N.W.	1957	8	143	Gd	D	114	1957	1500	---	More than 4 ppm iron
43N 34W 19-1	NW SW	Johnson	---	----	3	---	Gd?	O	67.44	11-18-65	1590	197	Ore expl. hole
19-2	NE SW	Johnson	---	----	3	---	Gd?	O	73.92	11-18-65	1620	---	Ore expl. hole
24-1	NW SE	Edw. Schlasser	Tuominen	1964	5	36	Gd	D	2	1964	1420	---	
24-2	NW SE	J. Strazer	Tuominen	1964	5	32	Pcr	D	2	1964	1420	27	
24-3	NW SE	W. J. Phillips	Kleiman	1964	6	38	Gd	D	4	1965	1420	---	
28-1	NE NE	Bates Twp.	Layne N.W.	----	6	140	Gd	P	-----	----	1630	---	Twp. #1, stand-by unit
28-2	NE NE	Bates Twp.	Layne N.W.	----	6	140	Gd	P	-----	----	1630	---	Twp. #2
29-1	SW NE	Rogers Mine	---	----	48	---	Gd	O	16.75	11-18-65	1567	---	Mine drainage well
43N 35W 11-1	SE NE	J. J. Javerski	---	----	36	47	Gd	D	41.83	11-1-65	1565	---	WMP obs. well
13-1	SW SE	F. Gendzwill	---	----	3	576	Pcr	O	54.99	11-18-65	1635	64	Ore expl. hole
16-1	SE NE	Iron River Twp.	Layne N.W.	1956	10	84	Gd	P	19	1956	1530	83	Rodine well
21-1	SW SE	Iron River Twp.	Layne N.W.	----	10	60	Gd	P	22.20	5-13-65	1540	---	Nash well
22-1	NW NE	Iron River Twp.	Layne N.W.	1956	10	150	Gd	T	-----	----	1600	---	Test hole, dry
23-1	NW NE	M. A. Hanna Co.	Layne N.W.	1963	48	80	Gd	I	36	1963	----	103	Mine drainage well
24-1	NE SE	Johnson	E. J. Long-year Co.	1945	3	113	Gd	O	69.71	11-18-65	1600	113	Ore expl. hole

Well number	Location in section	Owner	Driller	Date drilled	Diameter	Depth	Aquifer	Use	Water level	Date	Altitude	Depth to bedrock	Remarks
43N 35W 25-1	SE NW	City of Stambaugh	---	1938	18	81	Gd	P	18	1946	1480	---	City #1; stand-by unit
25-2	SE NW	City of Stambaugh	Layne N.W.	1962	8	80	Gd	P	11.20	5-12-65	1480	---	City #2
26-1	SW NE	City of Iron River	Layne N.W.	----	2	130	Gd	O	25.64	11-18-65	1480	---	Test hole
26-2	SW NE	City of Iron River	---	1947?	20	170	Gd	P	-----	----	1480	---	City #2; stand-by unit
26-3	SW NE	City of Iron River	Layne N.W.	1952	16	130	Gd	P	34	1952	1480	---	City #1
28-1	SE SW	Lewis Gregg	---	----	36	20	Gd	D	15.90	9-12-45	1540	---	Destroyed
33-1	SE NW	Mich. Hwy. Dept.	WMP	----	1¼	12	Gd	O	5.25	11-1-65	1525	---	WMP obs. well
44N 31W 26-1	NE SE	T. J. Bailey	Kleiman	1964	4	39	Gd	D	21	1964	1395	---	
26-2	NE SE	T. J. Bailey	Kleiman	1961	3	43	Gd	D	15	1961	1395	---	On lot next to 26-1
26-3	NW SE	W. Hosking	Kleiman	1961	3	57	Gd	D	29	1961	1400	---	
26-4	NE SW	A. Peterson	Kleiman	1961	3	54	Gd	D	29	1961	1400	---	
26-5	SE SE	V. Ball	Kleiman	1961	3	41	Gd	D	3	1961	1390	---	
34-1	SE NW	F. Phelan	Kleiman	1957	6	100	Pcr	P	30	1957	1400	50	Supplies 8 cottages
44N 32W 16-1	SW NE	E. Bicigo	Owner	----	1¼	20	Gd	P	10±	1965	1385	---	
17-1	NW SE	M. Smith	Tuominen	----	6	170·	---	P	-----	----	1390	---	Supplies 4 cottages
44N 33W 6-1	NW SW	M. Vireen	---	----	6	125	---	D	-----	----	1555	---	
7-1	SE NW	Robert Jacabson	Tuominen	1965	5	33	Gd	D	20	1965	1500	---	
7-2	NE SE	V. Hanttula	Tuominen	1963	5	146	Pcr	D	-----	----	1490	---	Ledge nr. surface
7-3	NE NW	Henry Rajala	Tuominen	----	4	132	Pcr	D	-----	----	1515	103	
8-1	NE NE	Hematite Twp.	---	1947	21	44	Gd	P	5	1963	1445	---	Yield dropped, well abandoned
8-2	NE NE	Hematite Twp.	Layne N.W.	1937	8	30	Gd	P	4.95	5-5-65	1445	---	Twp. well #2, stand-by unit
8-3	NE NE	Hematite Twp.	Layne N.W.	1963	12	30	Gd	P	-----	----	1445	---	Gravel pack
10-1	SW SW	Iron Co. Rd. Comm.	WMP	----	1¼	9	Gd	O	6.65	11-1-65	1540	---	WMP obs. well
16-1	NW NW	Crystal Falls Twp.	Layne N.W.	1950	8	56	Gd	P	8	1965	1450	---	Twp. well #1, gravel pack
16-2	NW NW	Crystal Falls Twp.	Layne N.W.	1965	16	58	Gd	P	7	1965	1450	---	Twp. well #3, gravel pack
17-1	SW SW	Stuart Dickinson	Tuominen	1962	5	29	Gd	D	10	1962	1395	---	
35-1	NW SE	A. Anderson	Tuominen	1961	5	31	Gd	D	-----	----	1410	---	
35-2	NW SE	Rev. C. Peterson	Tuominen	1965	5	17	Gd	D	4	1965	1410	---	
45N 31W 7-1	SE SE	Harry Patrick	---	----	1¼	---	Gd	P	-----	----	1490	---	
24-1	SE SE	K. Mattila	Owner	----	1¼	20	Gd	D	-----	----	1460	---	
25-1	NE NW	Chas. Blaim	Owner	----	1¼	25	Gd	D	-----	----	1450	---	Occasionally has musty smell
26-1	NW NE	J. Albrecht	Anderson	1961	5	99	Pcr	P	17	1961	1445	---	
45N 32W 5-1	SE SE	A. Rogers	Owner	1957	1¼	24	Gd	D	-----	----	1560	---	
29-1	SW SW	A.&L. Aaschliman	Former owner	----	1¼	30	Gd	D	-----	----	1540	---	Dry awhile in '63
45N 33W 8-1	SW SW	Basilio Prandi	WMP	1959	1¼	33	Gd	O	27.11	11-1-65	----	---	WMP obs. well
8-2	SW SW	Basilio Prandi	Tuominen	----	6	91	Gd	D	-----	----	1570	---	
10-2	SE NW	Ervin Evans	---	----	1¼	32	Gd	D	9.04	5-5-65	1540	---	
18-1	NW NW	F. Columbino	---	----	6	41	Gd	D	18.71	8-19-65	1545	---	
46N 31W 30-1	NE SW	USGS	USGS	1965	1¼	8	Gd	O	0	11-11-65	1560	- -	Casing removed
46N 33W 6-1	NE SW	Joseph Lang	---	1945	---	125	Pcr	D	-----	----	1520	40	
18-1	SW NW	Mich. Hwy. Dept.	WMP	----	1¼	13	Gd	O	8.25	11-1-65	1550	---	WMP obs. well
46N 34W 13-1	SW NW	J. Poulos	---	----	6	---	Gd	D	31.78	5-5-65	1520	---	
14-1	NE NW	Oliver Iron Mining Co.	WMP	----	1¼	12	Gd	O	7.30	11-1-65	1520	---	WMP obs. well

MARQUETTE COUNTY

WELL RECORDS

WELL DATA

Township and Range	Section No.	Well No.	Location within Section 1/4	1/4	Well Depth (feet)	Well Diameter (inches)	Elevation of Ground Surface at Well (feet)	Water Bearing Unit	Yield (gal/min)	Specific Capacity (gpm/ft)	Depth to Water (feet)	Date of Measurement	Remarks
42N [illegible]	—	[illegible]	[illegible]	[illegible]	22	—	990	Br			18	1970	Dug well
	2	2	SE	NW	40	5	980	Br			10		Water is cloudy
	11	1	SW	NW	45	5	960	Br			11	—	
42N25W	1	1	SE	NE	72	6	1040	Br			16	1969	Supplies Dwelling
	7	2	NE	SE	293	—	1020	Br			—	—	
	10	1	SE	SE	40	6	1030	Br			—	—	
	22	1	NE	SE	48	6	1000	Br			—	—	Water very hard
	32	1	NE	NE	55	5	1020	Br			22	1968	
	32	2	NE	NW	55	—	1020	Br			—	—	
42N26W	2	1	SE	SE	40	6	1060	Br			—	—	Water very hard
	4	1	SE	SE	75	5	1120	Br			35	—	
	5	1	SE	SE	38	6	1100	Br			—	—	
	12	1	SW	NE	60	5	1040	Br			—	—	
43N [illegible]W	29	1	SW	SW	42	4	1000	Br			42	1958	Campground well
	33	1	SW	SE	61	5	1010	Br			61	1969	
	34	1	SW	SW	94	5	1030	Br			—	—	
	35	1	SE	SW	52	5	1000	Br			—	—	
43N25W	5	1	SE	SW	60	6	1060	Br			5	1970	
	31	1	SW	SE	65	5	1100	Br			15	1960	Very hard water
	31	2	SW	SW	85	5	1100	Br			27	1967	
43N26W	36	1	SW	NW	73	6	1100	Br			27	1970	Very hard water
	27	1	SW	SW	—	—	—	B			73	1970	
44N [illegible]W	29	1	SW	NW	—	—	1070	Br			3	1970	
44N [illegible]W	25	1	NW	SE	40	5	1090	Br			[illegible]	1967	Water very hard
44N26W	6	1	SW	NE	67	5	1120	Gd			67	1968	
[illegible] 26W	12	1	SE	SE	34	2	1120	Gd			34	—	Campground well
	28	1	NE	[illegible]	28	6	1120	Br			2.3	10-26-70	
[illegible]	2	1	NW	[illegible]	46	5	1100	Br			7	1965	Supplies 2 dwellings

WELL DATA

Township and Range	Section No.	Well No.	Location within section 1/4	1/4	Well depth (feet)	Well diameter (inches)	Elevation of ground surface at well (feet)	Water bearing unit	Yield (gal/min)	Specific capacity (gpm/ft)	Depth to water (feet)	Date of measurement	Remarks
45N21W	7	1	NE	[illegible]	50	5	1150	Br			15	1970	Water very hard
	7	2	SE	NE	58	6	1160	Br			10	1964	Sample clear
	8	1	NW	SW	30	5	1140	Br			6	1970	
	14	1	NW	NW	42	5	1100	Br			15	1967	
	22	1	NE	NE	22	5	1100	Br			26	1969	
45N24W	20	1	NW	[illegible]	30	2	1120	Gd			—	—	Campground well
	20	2	SE	SW	109	5	1115	Gd			4	1967	
		1	NW	NW	40	1¼	1115	Gd			10	1970	
	5	1	SW	SW	60	1¼	—	Gd			1116.42 (elevation)	1964	
45N25W	25	1	NE	NE	47	1¼	1120	Gd			—	—	
	27	1	SE	NW	68	5	1110	Gd			11	1968	
	28	2	NW	NE	40	10	1100	Gd			10	1965	
	28	3	NW	NE	37	8	1100	Gd			15	1962	log to 10[illegible]
		1	SW	NW	62	1¼	—	Gd			1105.28 (elevation)	7-21-64	47°
	22	1	NW	SE	65	1¼	—	Gd			1104.88 (elevation)	—	47°
	28	1	NE	NW	98	240	—	Gd			1090.46 (elevation)	5-31-63	
45N26W	25	1	NW	NW	160	5	1185	Gd			24	1970	
	26	1	NE	SE	77	5	1200	Gd			28	1970	Supplies dwelling
	29	1	SE	SW	30	2	1220	Gd			30	—	
	8	1	NE	NE	15	1¼	—	Gd			(1209.75) (elevation)	7-22-64	
	15	1	SW	NE	20	1¼	—	Gd			1184.25 (elevation)	7-22-64	
42N26W	11	1	NW	NE	180	6	1460	Br			14[illegible]	—	
	11	2	SE	NW	60	6	1430	Gd			420	1969	
	[illegible]	1	NE	SE	32	14	—	Gd			1424.32 (elevation)	7-22-64	
45N33W	1	1	SW	NW	30	36	1540	Gd			26.20	4-29-66	
	[illegible]	2	SW	NW	126	6	1540	Br			50	1962	
	[illegible]	1	NE	[illegible]	117	5	1560	Gd			54	1967	
	[illegible]	2	NE	[illegible]	72	5	1560	Gd			72	1967	

WELL DATA

TOWNSHIP AND RANGE	SECTION NO.	WELL NO.	LOCATION WITHIN SECTION 1/4	1/4	WELL DEPTH (FEET)	WELL DIAMETER (INCHES)	ELEVATION OF GROUND SURFACE AT WELL (FEET)	WATER BEARING UNIT	YIELD (GAL/MIN)	SPECIFIC CAPACITY (GPM/FT)	DEPTH TO WATER (FEET)	DATE OF MEASUREMENT	REMARKS
45N 30W	5	1	NE	SW	52	6	1560	Gd			33	1965	
	5	2	NE	SW	52	6	1560	Gd			34	1965	
	5	3	NW	SE	26	3	1530	Gd			8	1961	
	8	1	NE	NW	42	6	1535	Gd			15	1965	
	13	1	NE	SW	45	6	1500	Gd			14	1968	
	19	1	SE	NW	20	6	1470	Gd			6	1966	
	22	1	SW	NE	54	4	1500	Gd			24	1966	
	26	1	SE	SE	137	6	1480	Br			40	1969	
	26	2	SE	SE	57	5	1480	Gd			31	1969	
	26	3	NE	SE	75	5	1490	Gd			55	1967	
	28	1	NW	NE	69	5	1500	Gd			44	1969	
	28	2	SW	NW	60	5	1500	Gd			47	1969	
	30	1	SE	NW	50	5	1450	Gd			16	1969	
40N 23W	6	1	SE	SE	84	5	780	Br			5	1968	
	7	1	SW	SW	107	6	850	Br			65	1968	Very hard water
	7	2	SW	SW	101	4	845	Br			—	—	Hard water
	18	1	SE	SE	100	5	960	Br			45	1968	
	9	1	NW	SE	75	5	960	Br			25	1968	
	19	3	SE	NE	9Y	5	940	[illegible]			21	1968	
	25	1	SE	SW	100	6	1070	Br			—	—	[illegible] dwelling
	29	1	SW	NW	170	6	1080	Br			38	196[illegible]	
	29	2	SE	SE	55	6	1100	Br			—	—	
	30	1	NE	SE	85	5	1100	Br			25	1956	
	32	1	NW	SE	55	6	1100	Br			25	1970	
[illegible]	1	1	SW	SE	62	6	760	Br			10	1968	
	2	1	SW	SW	116	5	790	Br			45	1969	
	11	1	SW	[illegible]	190	5	[illegible]	Br			1	[illegible]	
	11	2	SW	SW	111	5	[illegible]	Br			25	[illegible]	

WELL DATA — ( ) = Elevation

Township and Range	Section No.	Well No.	Location within Section ¼	¼	Well Depth (feet)	Well Diameter (inches)	Elevation of Ground Surface at Well (feet)	Water Bearing Unit	Yield (gal/min)	Specific Capacity (gpm/ft)	Depth to Water (feet)	Date of Measurement	Remarks
46N24W	–	.	NE	NW	150	5	780	Br			25	1968	
	23	1	SE	SW	25	—	880	Gd			—	—	Water high in iron
	24	1	NW	NE	88	5	900	Br			34	1968	
	36	1	NW	NW	62	—	880	Gd			—	—	
	36	1	SW	NE	60	6	780	Br				—	
46N25W	2	1	NE	[illegible]	12	[illegible]	—	Gd			(1171.88)	1-22-64	
	5	1	SW	SW	34	1¼	—	Gd			(767.37)	7-22-64	48°
	9	1	SW	SW	85	1¼	—	Gd			(1144.77)	7-21-64	48°
	11	1	NW	SW	193	6	—	Gd	70		(1062.00)	2-25-63	52°
	16	1	SE	SE	48	1¼	—	Gd			(1159.13)	7-21-64	47°
	36	5	NW	SW	144	12	—	Gd	750		(1090.66)	7-22-64	
	36	6	NW	SW	144	12	—	Gd	1000		(1089.84)	7-22-64	
46N26W	2	1	[illegible]	SW	47	1¼	—	Gd			—	–	
	12	1	SE	SE	24	1¼	—	Gd			(1177.41)	7-21-64	48°
	21	1	SW	SW	32	1¼	—	Gd			(1238.76)	7-24-64	47°
46N27W	2	1	SW	NE	100	1¼	—	Gd			—	—	
	17	1	SE	SE	31	1¼	—	Gd			(1396.56)	7-21-64	49°
	19	1	SW	SE	62	1¼	—	Gd			(1423.87)	7-21-64	48°
	31	1	SW	SW	71	1¼	—	Gd			(1413.14)	7-21-64	49°
46N28W	1	1	SE	NW	96	6	—	Gd			(1432.36)	7-21-63	50°
	[illegible]	1	SW	NW	22	1¼	—	Gd			(1452.15)	7-21-64	50°
	[illegible]	1	NW	SW	49	1¼	—	Gd			(1403.00)	11-14-62	
	12	5	NW	SW	15	1¼	—	Gd			(1409.85)	7-22-64	
	15	1	NE	SE	35	1¼	—	Gd			(1427.29)	7-22-64	48°
	27	1	NE	SE	71	1¼	—	Gd			(1412.78)	7-22-64	49°
	32	1	SE	SW	28	1¼	—	—			(1435.80)	7-22-64	49°
[illegible]	9	1	NE	–	44	6	—	Gd			6	[illegible]	
	1[illegible]	1	[illegible]	NW	11[illegible]	—	1480	Br			20	1968	

WELL DATA

( ) = Elevation

Township and Range	Section No.	Well No.	Location within section 1/4	1/4	Well Depth (feet)	Well Diameter (inches)	Elevation of Ground Surface at Well (feet)	Water Bearing Unit	Yield (gal/min)	Specific Capacity (gpm/ft)	Depth to Water (feet)	Date of Measurement	Remarks
46N27W	18	2	NW	SE	50	6	1480	Gd			14	1961	
	17	3	NW	SE	56	6	1490	Gd			13	—	
	18	4	NW	SE	62	6	1480	Gd			13	1964	[illegible]
	18	5	NW	SE	46	12	1480	Gd			15	1968	
	30	1	NW	NE	60	6	1480	Gd			7	1961	
	18	6	NW	SE	33	1¼	—	Gd			(1475.87)	7-12-64	50°
	22	1	NW	NE	31	1¼	—	Gd			(1492.32)	7-21-64	47°
	20	1	NE	NE	[illegible]	6	—	Gd			(1537.10)	8-23-63	
	36	1	SW	NE	32	1¼	—	Gd			(1469.79)	7-21-63	50°
46N30W	16	1	NW	SW	62	6	29	Gd			29	1958	
	22	1	NW	NE	51	5	20	Gr			20	1968	
	26	1	NE	SW	99	5	40	Br			40	1969	
	13	1	NW	NE	47	6	—	Gd			(1490.53)	5-16-62	49°, 20 gpm
47N23W	3	1	NW	NE	50	6	610	Br			7	1969	
	7	1	SW	SW	48	5	640	Gd			28	1	
47N24W	10	1	SW	NE	28	1¼	615	Gd			—	—	
	11	1	SE	NW	204	5	615	Br			8	1969	
	15	1	NW	SW	210	4	700	Gd			94	1965	Main supply
	15	2	NE	SW	145	6	700	Gd			87	1964	Back up supply
	21	1	SE	SE	125	5	680	Gd			21	1969	
	21	2	SE	SE	155	7	680	Br			[illegible]	1969	Abandoned water
	21	3	SE	SE	63	7	680	Gd			[illegible]	1969	
	[illegible]	1	SW	SE	126	5	700	Gd			82	[illegible]	
	18	1	SE	SW	75	2	—	—			(672.70)	1969	
	28	1	SW	SW	91	1¼	·	Gd			(679.53)	1969	
	35	1	NE	NW	220	6	820	GR			140	1968	Main supply
	35	2	NE	NW	170	5	820	Gd			—	1970	Part of supply
	35	2	NE	NW	167	5	820	Gd				[illegible]	

WELL DATA

Township and Range	Section No.	Well No.	Location within Section ¼	Location within Section ¼	Well Depth (Feet)	Well Diameter (Inches)	Elevation of Ground Surface at Well (Feet)	Water Bearing Unit	Yield (Gal/Min)	Specific Capacity (GPM/FT)	Depth to Water (Feet)	Date of Measurement	Remarks
47N24W	35	4	SW	SE	130	5	740	BR			65	1967	
	35	5	NW	SE	132	5	760	BR			45	1968	
47N27W	12	1	NE	SW	36	1¼	—	Gd			676	1964	
	15	1	SW	SW	235	6	—	Gd			(1016.56)	1964	
	19	1	SW	SW	86	1¼	—	Gd			(1184.92)	1964	
	20	1	SW	SW	103	1¼	—	Gd			(1150.39)	1964	
	21	1	SW	SW	161	1¼	—	Gd			(1093.00)	1964	
	22	2	SE	NW	135	1¼	—	Gd			(986.29)	1964	
	27	1	SE	SW	82	1¼	—	Gd			(1016.74)	1964	
	32	1	NE	SW									
47N26W	29	1	SW	NW	34	8	1290	Gd			16	1957	STAND BY UNIT
	29	2	SW	NW	38.	10	1290	Gd			—	—	MAIN SOURCE
	24	1	SW	NE	32	1¼	—	Gd			(1203.16)	1964	48°
	25	1	NE	NE	35	1¼	—	Gd			(1199.86)	1964	
	25	2	NW	SW	26	1¼	—	Gd			(1203.68)	1964	47°
	25	3	NW	SE	26	1¼	—	Gd			(1203.99)	1964	47°
	26	1	NW	SE	35	1¼	—	Gd			(1210.79)	1964	47°
	29	3	SW	NW	34	8	—	Gd			(1274.0)	1957	200 GPM
	30	3	SW	NE	50	12	—	Gd			(1292.0)	1962	200 GPM
	35	1	NW	NW	15	1¼	—	Gd			(1201.87)	1964	45°
	36	1	NW	NW	28	1¼	—	Gd			(1203.22)	1964	
	36	9	NW	NW	65	8	—	Gd			(1203.08)	1964	44°, 310 GPM
47N27W	8	1	SE	NW	162	6	—	Gd			—	—	
47N22W	12	1	NE	SW	97	5	1490	Gd			F	1967	MAIN SOURCE
	12	2	NE	SW	30	8	1490	Gd			—		
	1	1	NW	SE	206	48	—	Gd			(1499.81)	1963	
	3	1	SW	SW	68	8	—	Gd			(1559.72)	1964	RECORDER
	4	1	NE	NE	95	8	—	Gd			(1567.64)	1964	

WELL DATA

Township and Range	Section No.	Well No.	Location within Section 1/4	Location within Section 1/4	Well Depth (feet)	Well Diameter (inches)	Elevation of Ground Surface at Well (feet)	Water Bearing Unit	Yield (gal/min)	Specific Capacity (gpm/ft)	Depth to Water (feet)	Date of Measurement	Remarks
[illegible]	[illegible]		[illegible]	[illegible]	12	[illegible]		[illegible]			(555.55)	1964	47°
	[illegible]		[illegible]	[illegible]	-	6		GD			(1572.01)	1962	
			[illegible]	[illegible]	30	2	—	GD			(1515)	1963	
	15	1	[illegible]	[illegible]	38	1¼	—	[illegible]			(1502.38)	1964	47°
			[illegible]		[illegible]	[illegible]		[illegible]			(1497.25)	1964	48°
	25	1	NW	SW	52	1¼	—	GD			(1490.21)	1964	47°
[illegible]	[illegible]	1	NE	NE	57	7	610	GD			6	—	
	[illegible]	[illegible]	SW	SE	91	5	1010	GD			40	1968	
	8	2	SW	SW	70	5	1010	GD			35	1966	
48N26W	7	1	SW	SE	97	5	1420	GD			39	1967	
	23	1	SW	NE	39	6	1310	GD			25	1968	
	28	1	NW	NE	55	6	—	GD			(1396.30)	7/21/64	47°
	34	1	NE	SE	31	1¼	—	GD			(1273.49)	7/21/64	46°
48N28W	30	1	NW	NW	1¼	20	—	GD			(1559.39)	7/21/64	
	32	1	NE	SE	38	96	—	GD			(1550)	6/4/62	
	32	2	NE	SE	50	6	—	GD			(1550)	"	
48N29W	31	1	NW	SW	110	6	1690	GD			9	1953	supplies 2
	19	1	SE	SW	31	1¼	—				(1551.61)	7/21/64	
	26	1	SE	SW	32	1¼	—	GD			(1554.67)	"	
	31	2	SE	NW	89	6	—	GD			(1593)	5/16/62	
48N30W	21	1	NE	SW	41	6	1600	GD			15	1968	
47N26W	2	1	NW	SW	77	5	740	Br			28	1969	
	12	1	SE	SE	66	5	605	Br			3	1967	water red
50N26W	19	1	NW	NW	99	5	750	Br			28	1967	
50N27W	14	1	NE	NW	96	5	750	Br			13	1969	
	14	2	NW	NE	92	5	740	Br			7	1969	
50N28W	4	1	NW	SW	23	1¼	1120	GD			—	—	
51N27W	1	1	NE	SW	126	5	640	Br			52	1968	

WELL DATA

Township and Range	Section No.	Well No.	Location within Section 1/4	1/4	Well Depth (feet)	Well Diameter (inches)	Elevation of Ground Surface at Well (feet)	Water Bearing Unit	Yield (gal/min)	Specific Capacity (gpm/ft)	Depth to Water (feet)	Date of Measurement	Remarks
51N 27W	9	1	NE	SE	683	5	700	Br			30	1968	
	14	1	SE	NW	26	1 1/4	630	Gd	25-30		5	1969	
	14	2	NE	NE	87	5	630	Br			7	1967	high iron content
	15	1	SE	NW	156	—	620	Gd?			—	—	
51N 28W	1	1	NE	NW	55	6	628	Gd			—	—	
52N 28W	21	1	NW	SE	200±	8	620	Br			20	1949	
	21	2	NW	SE	200±	8	620	Br			—	—	
	21	3	NW	SE	26	2	620	Gd			—	—	
	27	1	NW	SE	135	6	630	Br			—	—	

MENOMINEE COUNTY

WELL RECORDS

Records of wells

Well number: The well numbering system used in this report is based on the location of the well. The first two segments of the well number designate the township and range. The third segment designates the section and a number assigned to each well in a section. Thus, well 40N 29W 8-1 is well number 1 in section 8, township 40 north, range 29 west.

Water-bearing strata: gd - glacial drift; gg - glacial gravel; ul - upper limestones; mls - middle limestones and sandstones; ls - lower sandstones; Pcr - Precambrian rocks. (Note: for geologic names of water-bearing strata, see table 1).

Use: D - domestic; S - stock; P - public supply; I - industrial; N - not used.

Specific capacity: Yield in gallons per minute per foot of drawdown.

Altitude: Altitudes are in feet above mean sea level, as estimated from U. S. Geological Survey topographic maps.

Well number	Location	Owner	Driller	Date drilled	Diameter	Depth	Water-bearing unit	Use	Water level	M or R	Date	Specific capacity	Altitude	Depth to bedrock	Remarks
38N 28W															
5-1	NW¼ NW¼; section 5	Julius Van Viele	J. Van Viele	1947	6	80	gg	D	35	R	1962	---	980	---	
9-1	SE¼ NW¼; section 9	Craig Johnston	E. Klieman	1961	3	19	gg	I	8	R	6-1-61	.66	843	---	
11-1	NW¼ NW¼; section 11	Dr. Arthur Costa	Wm. Klieman	1959	6	57	gg	D	26.5	R	9-2-59	---	950	---	
22-1	NW¼ NW¼; section 22	Walter LaGrave	F. Kosikowski	1961	5	62	gg	D	21.5	R	1961	4	865	---	
26-1	SE¼ SW¼; section 26	Charles Hanna	F. Kosikowski	1961	5	106	gg	D	13	R	1961	1.5	855	---	
38N 27W															
2-1	SW¼ SE¼; section 2	Ted Peterson	Henry Le Beau	1960	5	75	mls	D	19	R	1960	---	890	42	
2-2	NW¼ SE¼; section 2	Wildwood Restaurant	Henry Le Beau	1960	5	77	mls	D	26	R	11-30-60	8	900	60	
2-3	NE¼ SW¼; section 2	St. Mary's Parish	C. O. Rice	1951	--	120	mls	D	-----	-	----	---	920	---	Cased to 30 ft.
2-4	SE¼ SW¼; section 2	Frank Rodman	Henry Le Beau	1962	5	110	mls	D	-----	-	----	---	900	---	Bedrock near surface
2-5	NE¼ NE¼; section 2	Robert Petrick	Henry Le Beau	1961	5	60	mls	D	20	R	1961	---	905	---	
11-1	NW¼ NE¼; section 11	Alex Ginovra	C. O. Rice	1959	5	60	mls	D	12	R	10-6-59	1	900	47	Cased to 49 ft.
12-1	SE¼ SW¼; section 12	Rueben Erickson	T. Rice + Son	1945	5	65	mls	D	-----	-	----	---	---	---	Cased to 28 ft.
13-1	SE¼ SE¼; section 13	Ed Bellmonte	T. Rice + Son	1944	5	67	mls	D	-----	-	----	---	---	---	
15-1	NE¼ SW¼; section 15	Bill Moore	Thomas Co.	1960	4	75	mls	D	40	R	1960	---	---	2	
16-1	NE¼ SE¼; section 16	Bill Moore Mink Ranch	-----	----	--	400?	ls	S	-----	-	----	---	---	---	Reported to be more than 400 ft. deep.
37N 28W															
11-1	NE¼ SW¼; section 11	Edmund Hanna	F. Kosikowski	1961	5	62	ls	S	20	R	4-12-61	3.5	890	50	
37N 27W															
1-1	NW¼ SE¼; section 1	Andrew Benson	T. Rice + Son	1944	5	47	---	S	20	R	1962	---	---	---	Cased to 27 ft.
23-1	NW¼ NW¼; section 23	Lester Le Beau	T. Rice + Son	1944	5	45	mls	N	21.56	M	5-4-62	---	845	---	Cased to 23 ft.
37N 26W															
7-1	SE¼ SE¼; section 7	Hector Trembley	Henry Le Beau	1959	5	60	mls	S	13.5	R	10-10-59	---	830	35	Cased to 38 ft.
7-2	SE¼ SE¼; section 7	Sundquist + Fougetti	Dick Rice	1960	5	86	mls	D	28	R	11-20-60	---	---	---	Cased to 31 ft.
19-3	SE¼ NE¼; section 19	George Branske	T. Rice + Son	1943	5	40	mls	D	-----	-	----	---	800	---	Cased to 33 ft.
19-4	SE¼ NE¼; section 19	Carney School	T. Rice + Son	1944	6	41	mls	D	-----	-	----	---	800	---	
19-7	NE¼ NE¼; section 19	Peterson Bros. IGA Store	Henry Le Beau	1958	5	99	mls	D	-----	-	----	---	815	---	
19-8	NE¼ NE¼; section 19	Peterson Bros.	Henry Le Beau	1954	5	40	mls	N	4.08	M	9-14-59	---	---	---	
19-11	NW¼ SE¼; section 19	Carl Guard	Dick Rice	1960	5	48	mls	D	-----	-	----	---	785	---	Cased to 80 ft.
36N 28W															
8-1	NW¼ NE¼; section 8	F. Siebert	Thomas Co.	1961	6	40	gg	D	-----	-	----	---	760	---	
24-1	SW¼ SE¼; section 24	John Kipple	T. Rice + Son	1944	5	100	mls	D	-----	-	----	---	790	---	Cased to 60 ft.
36N 27W															
2-1	SE¼ SE¼; section 2	Frank Zouba	T. Rice + Son	1943	5	100	mls	N	20.24	M	7-26-62	---	760	---	Cased to 75 ft.

APPENDIX B

WELL YIELDS

BARAGA COUNTY

WELL YIELDS

WELL YIELDS

Well Number	Aquifer Br - bedrock Gd - glacial drift	Yield (gpm)	Drawdown (feet)	Duration of Test (hours)	Specific Capacity (gal/min/ft drawdown)
48N 31W 17-1	Br	4	67	1	0.06
35-2	Gd	6	61	10	0.16
48N 34W 21-1	Gd	10	20	24	0.50
49N 34W 14-1	Gd	115	32	5	3.60
51N 31W 8-1	Br	10	15	10	0.66
51N 32W 8-1	Gd	30	15	2	2.00
8-2	Gd	20	52	2	0.40
9-1	Gd	30	2	2	15.00
30-1	Br	3	85	2	0.03
51N 33W 28-1	Br	5	30	2	0.16
28-2	Br	5	30	2	0.10
32-1	Gd	5	45	2	0.11
36-1	Gd	20	5	4	4.00
52N 31W 32-1	Br	9	11	4	0.81
52N 33W 2-2	Br	50	100	48	0.50
14-1	Br	5	82	2	0.06
14-2	Br	5	86	2	0.06
14-3	Br	1.5	180	1	0.01
27-1	Br	10	4	2	2.50
27-2	Br	9	26	4	0.34
34-2	Br	10	20	2	0.50

DICKINSON COUNTY

WELL YIELDS

PUMP TEST RESULTS

Well Number	Aquifer Pc = Precambrian Pa = Paleozoic Gd = Glacial drift	Yield (gal/min)	Drawdown (feet)	Duration of test (Hours)	Specific Capacity (gal/min/ft/drawdown)
39N 28W 7-1	Pc	5	--	--	--
14-1	Gd	5	--	--	--
14-2	?	8	60	1	0.1
19-1	Pc	17	4	2	4.3
19-2	Pc	9	40	1½	0.2
19-3	Pc	12	--	--	--
20-1	Gd	30	--	--	--
20-2	Gd	20	15	2	1.3
24-1	Pa	240	--	--	--
30-1	Gd	5	6	½	0.8
30-2	Gd	40	10	2	4.0
30-3	Gd	5	--	--	2.5
30-4	Gd	10	4	¼	--
39N 29W 8-1	Gd	20	1½	2	13.3
22-1	Gd	15	4	8	3.8
25-1	Gd	30	10	2	3.0
36-1	Pc	20	10	2	2.0
39N 30W 3-2	Gd	125	12	8	10.4
4-1	Pc	20	10	--	2.0
40N 28W 12-1	Gd	4	90	½	0.04
26-1	Gd	3	40	1	0.8
35-1	Gd	3	5	2	0.6
40N 29W 28-1	Gd	3	8	1	0.4
40N 30W 8-1	Gd	15	4	4	3.8
17-1	Gd	3	8	1	0.4
18-2	Gd	30	5	8	6.0
18-4	Gd	12½	10	1	1.3
18-5	Gd	25	12	2	2.0
18-7	Gd	5	18	--	0.3
19-3	Gd	350?	--	6	--
21-1	Gd	15	4	3	3.8
23-1	Pc	6	56	2	0.1
28-1	Gd	30	20	6	1.5
40N 31W 24-1	Pa	15	3	1	5.0

IRON COUNTY

WELL YIELDS

WELL YIELDS

Well Number	Aquifer Pcr - Precambrian rocks Gd - Glacial drift	Yield (gal/min)	Drawdown (feet)	Duration of test (hours)	Specific capacity (gal/min/ft/drawdown)	Surface formation
41N 31W 14-1	Pcr	17	7	4	2.4	Moraine
41N 32W 11-1	Gd	30	5	2	6.0	Outwash
42N 31W 6-1	Gd	5	4	----	1.2	Outwash
42N 32W 15-1	Gd	480	43	----	11.0	Outwash
26-1	Gd	20	6	2	3.3	Outwash
29-1	Pcr	1	--	----	----	Till plain
42N 33W 1-1	Pcr	5	--	----	----	Till plain
1-2	Pcr	8	55	8	0.1	Till plain
13-1	Gd	60	--	----	----	Outwash
13-2	Gd	8	--	----	----	Outwash
15-2	Gd	5	--	----	----	Till plain
28-1	Gd	20	--	----	----	Outwash
42N 34W 9-1	Gd	300	19	4	15.7	Till plain
13-1	Gd	79	21	11	3.8	Till plain
25-1	Gd	20	4	6	5.0	Outwash
25-2	Gd	8	30	----	0.3	Outwash
42N 35W 1-1	Gd	240	--	8	----	Till plain (?)
1-2	Gd	480	16	9.5	30.0	Till plain (?)
11-1	Gd	125	--	----	----	Swamp deposit
20-1	Gd	15	5	2	3.0	Bedrock at or near surface
20-2	Gd	10	--	----	----	Bedrock at or near surface
43N 31W 4-1	Pcr	40	20	1	2.0	Outwash
16-1	Pcr	10	50	2	0.2	Till plain
24-1	Pcr	3	28	3	0.1	Outwash
26-1	Gd	10	4	2	2.5	Outwash
33-1	Gd	10	6	2	1.7	Outwash
35-1	Gd	30	6	1.5	5.0	Outwash
36-1	Pcr	6	14	----	0.4	Outwash
36-2	Pcr	16	2	----	8.0	Outwash
43N 32W 6-1	Gd	8	17	----	0.5	Moraine
21-1	Gd	250	--	----	----	Swamp deposit
21-2	Gd	400	--	----	----	Swamp deposit
21-3	Gd	400	--	----	----	Swamp deposit
21-6	Gd	30	--	----	----	Swamp deposit
28-2	Gd	150	--	----	----	Outwash
43N 33W 21-1	Gd	30	5	3	6.0	Till plain
31-1	Gd	50	--	2	----	Moraine
43N 34W 24-1	Gd	8	9	----	0.9	Moraine
24-2	Pcr	8	16	----	0.5	Moraine
24-3	Gd	30	10	2	3.0	Swamp deposit
28-1	Gd	200	--	----	----	Till plain
43N 35W 16-1	Gd	85	3	1	28.0	Outwash
21-1	Gd	250	--	----	----	Till plain
23-1	Gd	1,770	--	----	----	Till plain
26-2	Gd	400	--	----	----	?
44N 31W 26-1	Gd	10	--	----	----	Moraine
26-2	Gd	5	20	4	0.3	Moraine
26-3	Gd	35	5	4	7.0	Moraine
26-4	Gd	25	15	3	1.7	Moraine
26-5	Gd	30	10	2	3.0	Moraine
44N 33W 7-1	Gd	6	8	----	0.8	Till plain
8-3	Gd	200	--	6	----	Outwash
16-1	Gd	100	6	6	17.0	Till plain
16-2	Gd	400	--	11	----	Till plain
17-1	Gd	8	4	----	2.0	Till plain
35-1	Gd	3	10	----	0.3	Moraine
35-2	Gd	7	6	----	1.0	Moraine
45N 31W 26-1	Pcr	14	70	5	0.2	Outwash

APPENDIX C

WATER QUALITY

BARAGA COUNTY

WATER QUALITY

CHEMICAL ANALYSES OF WATER FROM WELLS
(ANALYSES ARE GIVEN IN MILLIGRAMS/LITER)

Township and Range	Section No.	Well No.	Location within Section 1/4	1/4	Date Sampled	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Total Dissolved Solids	Total Hardness as $CaCO_3$	Specific Conductance (micromhos at 25°C)	pH
47N 32W	25	1	See	Well Data	9/21/69	—	—	—	—	1.5	32	15	1.5	4.3	32	12	50	6.0
[illegible]	18	1	"		9/19/69	—	—	—	—	>5.0	—	9.0	1.0	0.1	130	105	245	6.8
48N 31W	17	1	"		8/20/69	—	—	—	—	0.40	93	7.0	1.3	0.0	104	74	160	7.9
	17	2	"		8/21/69	—	—	—	—	0.20	102	5.0	0.5	0.1	110	85	145	8.2
	17	3	"		"	—	—	—	—	<0.10	10	2.0	0.7	0.2	<30	12	<50	6.1
	21	1			9/21/69	—	—	—	—	75.00	—	8.0	4.5	0.0	117	90	200	7.4
	33	1			8/21/69	—	—	—	—	75.0	56	0.0	1.0	0.0	53	38	100	6.8
	35	1			9/17/69	—	—	—	—	<0.10	30	17	8.5	31	98	50	150	7.5
	35	2			"	—	—	—	—	2.00	35	16	0.5	0.5	55	34	85	7.6
	35	3			9/21/69	—	—	—	—	0.60	—	9.0	0.5	0.7	<30	10	<50	5.8
47N 32W	8	1			8/25/69	—	—	—	—	1.9	45	4.0	2.2	0.0	65	42	100	7.1
48N 32W	6	1			9/24/69	—	—	—	—	<0.10	—	11	1.0	5.7	220	182	340	7.5
48N 34W	18	1	"		9/23/69	—	—	—	—	<0.10	—	22	10	0.8	—	196	—	—
	18	2	"		"	—	—	—	—	0.60	205	18	0.0	0.1	221	142	340	8.5
	21	1			9/17/69	—	—	—	—	1.4	—	15	0.0	0.1	202	150	330	7.8
	21	2			9/23/69	—	—	—	—	75.0	—	7.0	1.0	2.3	—	39	115	[illegible]
	22	1	.		9/17/69	—	—	—	—	75.0	—	8.0	40	0.3	—	85	325	7.2
	22	2			9/24/69	—	—	—	—	0.30	—	7.0	32	4.8	—	78	255	6.5
	28	1			9/22/69	—	—	—	—	0.30	—	11	2.0	5.7	202	164	325	7.7
	29	1			"	—	—	—	—	0.10	127	9.0	0.5	0.2	130	86	220	[illegible]
	31	1			"	—	—	—	—	0.30	—	14	1.0	0.2	162	132	265	7.9
	[illegible]	1			"	—	—	—	—	1.9	—	7.0	0.0	1.2	—	124	235	7.4
48N 35W	34	1			9/17/69	—	—	—	—	0.10	110	10	5.0	1.1	133	98	220	[illegible]
47N 31W	[illegible]	1			[illegible]	—	—	—		>5.0	—	10	1.5	0.2	52	30	80	[illegible]
[illegible]	6	2			9/22/69	—	—	—	—	0.30	—	9.0	[illegible]	0.2	143	107	240	[illegible]
[illegible]	14	1			9/24/69	—	—	—	—	0.20	115	6.0	0.0	0.7	110	94	170	8.2

CHEMICAL ANALYSES OF WATER FROM WELLS
(ANALYSES ARE GIVEN IN MILLIGRAMS/LITER)

Township and Range	Section No.	Well No.	Location within section 1/4	1/4	Date Sampled	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Total Dissolved Solids	Total Hardness as $CaCO_3$	Specific Conductance (micromhos at 25°C)	pH
	28	1	see well data		9/19/69	—	—	—	—	0.30	44	8.0	1.0	0.2	52	35	80	7.8
S0N32W	18	1	"		9/22/69	—	—	—	—	75.0	—	6.0	0.0	0.0	101	65	155	6.3
S0N33W	3	1	"		9/23/69	—	—	.	—	1.10	139	7.0	159	0.1	468	255	880	7.8
	5	1	"		9/24/69	—	—	—	—	0.10	129	2.0	5.0	0.2	143	103	225	8.1
	10	1	"		"	—	—	—	—	0.10	209	7.0	4.0	0.2	214	110	350	8.5
	11	1			9/23/69	—	—	—	—	>75.0	—	11	0.5	0.1	97	64	150	6.9
	11	2	"		"	—	—	—	—	1.2	—	16	1.0	0.1	188	144	300	6.4
	22	1	"		9/11/69	—	—	—	—	0.20	—	10	3.5	0.1	143	103	220	8.3
	28	2	"		9/20/69	—	—	—	—	75.0	154	16	6.5	0.8	176	136	270	8.4
S0N34W	9	1	"		9/11/69	—	—	—	—	2.5	209	80	1.0	0.2	208	172	320	8.0
S1N31W	4	1	"		9/14/69	—	—	—	—	0.20	155	3.0	1.5	1.1	196	127	260	7.8
	8	1			"	—	—	—	—	6.30	56	4.0	1.5	0.1	71	46	110	6.5
S1N32W	9	1	"		8/13/69	—	—	—	—	1.1	175	0.0	0.3	0.1	182	128	280	8.0
	30	1	"		"	—	—	—	—	0.20	151	1.5	0.6	0.1	159	104	240	7.6
S1N33W	15	1	"		9/23/69	—	—	—	—	0.20	—	25	71	2.9	306	60	475	6.5
	28	1	"		9/9/69	—	—	—	—	2.5	—	10	4.5	0.1	84	50	130	6.2
	28	2	"		"	—	—	—	—	0.10	—	9.0	1.5	0.4	65	50	100	5.9
	32	1	"		"	—	—	—	—	<0.10	—	12	18	2.7	200	168	320	7.7
S1N34W	5	1	"		"	—	—	—	—	<0.10	—	5.0	1.0	0.7	208	154	320	7.8
	7	1	"		9/10/69	—	—	—	—	3.5		9.0	1.0	0.2	—	23	75	5.5
	9	1	"		9/9/69	—		—	—	<0.10	121	11	2.5	0.3	124	85	285	8.3
	16	1	"		9/[illegible]/69		—	—	—	0.20	101	54	19	0.4	202	92	330	8.2
	15	1			9/11/69	—	—	—	—	<0.10	—	10	1.0	0.3	—	250	500	7.3
	17	1			9/15/69	—	—	—	—	0.30	—	14	16	0.5	—	225	480	7.[illegible]
	18	1			"	—	—		—	0.10	137	12	3.0	3.4	136	97	210	[illegible]
	20	1			"	—			—	<0.10	124	10	2.5	0.5	127	92	[illegible]	[illegible]
	21	1			9/11/69	—	—		—	0.40	189	8.0	71	0.4	325	54	500	8.5
	21	1			"	—	—	—	—	1.0	—	11	3.5	2.4	75	50	115	5.5

CHEMICAL ANALYSES OF WATER FROM WELLS
(ANALYSES ARE GIVEN IN MILLIGRAMS/LITER)

Township and Range	Section No.	Well No.	Location within section 1/4	1/4	Date Sampled	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Total Dissolved Solids	Total Hardness as $CaCO_3$	Specific Conductance (micromhos at 25°C)	pH
	24	2	see well	data	9/11/69	—	—	—	—	1.3	—	14	3.5	2.1	38	15	55	5.4
	27	1	"		"	.	—	—	—	1.0	—	8.0	1.0	0.2	280	200	430	8.0
	36	1	"		9/9/69	—	—	—	—	<0.10	—	15	32	2.6	—	193	400	7.5
52N30W	16	1	"		9/12/69	—	—	—	—	<0.10	—	7.0	0.5	0.4	143	107	225	7.4
	20	1	"		8/14/69	.	—	—	—	<0.10	221	9.0	8.5	39	325	202	450	7.5
	28	1	"		8/19/69	—	—	—	—	0.10	108	5.0	6.5	17	156	91	230	6.0
52N31W	26	1	"		8/14/69	—	.	—	—	0.10	76	4.0	1.5	5.8	100	64	155	6.3
	27	1	"		"	—	—	—	—	<0.10	171	4.0	6.3	0.3	325	143	500	7.2
	27	2	"		9/18/69	—	—	—	—	1.8	—	11	5.5	0.3	—	61	240	7.0
	29	1	"		8/12/69	—	—	—	—	0.30	189	0.0	1.0	0.3	198	134	300	7.5
	32	1	"		8/13/69	—	—	—	—	<0.10	145	2.0	0.8	0.7	155	116	240	8.0
52N32W	33	1	"		8/13/69	—	—	—	—	3.8	167	0.0	0.3	0.0	175	126	260	7.9
	34	1	"		8/12/69	—	—	—	—	<0.10	190	1.0	0.5	0.1	202	130	300	7.9
52N33W	2	1	"		8/27/69	—	—	—	—	<0.10	106	31	68	0.2	280	94	450	8.3
	9	1	"		8/28/69	—	.		—	<0.10	38	14	620	0.0	1365	525	2100	7.6
	10	1	"		8/27/69	—	—	—	—	<0.10	168	0.0	1.0	0.0	169	132	265	7.8
	14	1	"		8/20/69	—	—	—	—	<0.10	151	12	39	0.0	247	100	400	7.7
	27	1	"		"	—	—	—	—	<0.10	134	5.0	2.5	0.2	143	82	230	7.3
	29	1	"		8/21/69	—	—	—	—	0.10	46	10	6.0	12.0	62	38	105	6.0
	29	2	"		8/27/69	—	—	—	—	0.20	146	18	5.0	0.1	182	36	280	8.1
	34	1	"		"	—	—	—	—	<0.10	184	5.0	3.0	0.1	195	94	300	7.7

SURFACE WATER QUALITY - BARAGA COUNTY

Lakes with outlets

Section & Number	Lake	Township	Range	Section	Location in Section	Date Samples	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Total Dissolved Solids	Hardness ($CaCO_3$)	Specific Conductance	pH	Temperature	Estimated Yield, gpm
28-1	CRAIG LAKE	49N	31W	28	SW-NE	9-22-69	0.50	6	11	1.0	0.1	<32	8	<50	6.7	16.0	—
27-1	KING LAKE	48N	35W	27	SE-NE	9-20-69	0.50	9	8.0	0.8	3.8	—	14	<50	6.9	13.0	—
24-1	WORM (VERMILAC) LAKE	46N	34W	24	NW-SE	9-20-69	0.30	10	6.0	1.0	1.4	—	15	<50	6.8	14.0	—
18-1	RUTH LAKE	48N	31W	18	SE-NE	8-12-69	.30	17	0.0	1.5	0.0	29	18	<50	6.9	20.5	—

SURFACE WATER QUALITY - BARAGA COUNTY

Lakes without "outlet"

Section & Number	Lake	Township	Range	Section	Location in Section	Date Samples	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Total Dissolved Solids	Hardness ($CaCO_3$)	Specific Conductance	pH	Temperature	Estimated Yield, gpm
28-1	Big Lake	49N	34W	28	NW-SW	9/19/69	.10	2	17	0.0	0.2	-	3	50	5.9	2.0	-
18-1	Laws Lake	50N	32W	18	NW-NW	9/22/69	.20	67	8.0	0.0	0.4	58	48	90	7.0	18.5	-
33-1	Petticoat Lake	48N	31W	33	SW-SE	8/21/69	-	17	1.0	0.1	0.1	-	14	50	6.8	24.0	-

SURFACE WATER QUALITY - BARAGA COUNTY

Springs

Township	Range	Section	Location in Section	Date Samples	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Total Dissolved Solids	Hardness ($CaCO_3$)	Specific Conductance	pH	Temperature, °C	Estimated Yield, gpm
47N	31W	32	SE-NW	9-21-69	.50	—	11	0.5	0.3	55	35	85	5.8	8.5	10
48N	34W	17	NE-NE	9-19-69	0.10	166	12	10	1.7	214	139	330	7.7	8.0	2
49N	32W	6	SW-SW	9-22-69	1.3	140	9.0	3.0	1.3	155	122	245	7.9	14	—
49N	33W	18	SW-SE	9-10-69	0.50	—	8.0	18	1.6	—	85	220	6.9	—	—
50N	32W	18	SW-NE	9-22-69	2.2	107	12	1.0	0.3	114	85	200	7.3	8	2
50N	33W	28	SE-SW	9-20-69	0.30	—	15	15	2.7	159	114	250	6.9	8.5	2
51N	33W	25	NW-SE	8-12-69	0.50	32	4.0	8.5	0.1	65	50	115	5.9	12	3
52N	31W	19	SW-NW	8-13-69	<0.10	—	—	—	—	—	50	110	5.9	9.5	1
53N	31W	35	SW-SE	8-13-69	0.10	33	5.0	1.1	1.0	55	35	95	5.9	9.5	1

SURFACE WATER QUALITY - BARAGA COUNTY

Section & Number	Stream	Township	Range	Section	Location in Section	Date Samples	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (CL)	Nitrate (NO_3)	Total Dissolved Solids	Hardness ($CaCO_3$)	Specific Conductance	pH	Temperature	Estimated Yield, gpm
1-1	Hazel Creek	50N	34W	1	NE-SW	8/26/69	0.1	119	3.0	1.2	0.3	127	93	195	7.6	12	-
35-1	Huron River	52N	30W	35	NW-NW	8/19/69	0.1	66	3.0	1.0	0.1	65	50	100	7.8	10	-
26-1	Peshekee River	50N	31W	26	SW-NW	9/18/69	0.5	29	7.0	0	1.0	39	29	60	7.8	13	-
18-1	Silver River	51N	31W	18	SW-NW	8/14/69	0.4	-	-	-	-	-	65	115	8.5	19	-
12-1	Six Mile Creek	50N	34W	12	NW-NW	8/28/69	-	105	1.5	0.8	0.1	107	80	160	7.5	14	-
8*	Slate River	51N	31W	8	SE-NE	8/19/69	.10	68	3.0	1.0	0.2	75	54	115	7.5	18.5	-
8-1	Tioga River	48N	32W	8	SW-NW	8/20/69	0.50	51	0.0	0.5	0.1	54	42	83	7.1	150	-

*Source 8 does not appear on the Surface Water Data Map.

DELTA COUNTY

WATER QUALITY

Chemical analyses of ground-water samples in Delta County

Aquifer:

Depth: Sampling point in well, in feet below land surface. Where depth is not indicated, sample was collected from pump discharge or flow at well head.

Analyst: M, Michigan Department of Health; U, U. S. Geological Survey.

Potassium: + indicates potassium (K) included in value listed under sodium (Na).

Well number	Aquifer	Depth	Analyst	Date collected	Chemical constituents (parts per million) Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Total solids	Hardness as $CaCO_3$	pH	Specific conductance (micromhos at 25°C)	Temperature (°F)
43N 23W																				
6-1	Otb	-	M	10-24-58	-	-	56	27	7	-	312	0	2	-	-	-	250	-	500	-
21-3	Cgd	-	M	3- 3-53	-	14	-	-	-	-	-	-	-	-	-	-	490	-	-	-

DICKINSON COUNTY

WATER QUALITY

LABORATORY ANALYSES OF WELL WATER

(By U. S. Geological Survey and Michigan Dept. of Health)

Well Number	Aquifer	Date Collected	Analyst	Chemical constituents in parts per million: Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na+K)	Bicarbonate (HCO_3)	Sulphate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Dissolved solids	Hardness ($CaCO_3$)	Specific Conductance (Micromhos @ 25°C)	pH
44N 28W 10-1	Gd	7/31/64	USGS	----	--	--	----	184	19	1.5	0.1	---	189	314	8.1
43N 30W 29-3	Gd	1959	MDH	0.75	66	33	7.2	322	30	13	----	335	300	---	---
43N 30W 9-2	Pc	8/ 5/64	USGS	----	--	--	----	261	14	2.5	0.1	---	222	414	7.8
42N 28W 35-2 (Spring)	Gd	9/15/64	USGS	----	--	--	----	292	19	4.5	4.6	---	303	501	8.4
42N 28W 29-1	Pc	9/11/64	USGS	----	--	--	----	252	13	5.0	0.2	---	202	413	7.8
42N 27W 20-1	Pa	9/14/64	USGS	----	--	--	2.1	262	29	1.5	0.1	---	275	447	7.4
40N 30W 31-1	Gd	10/6/64	USGS	----	--	--	----	404	65	15	3.8	---	468	746	7.6
39N 30W 3-1	Gd	8/14/58	MDH	0.00	72	00	14.1	282	37	23	31	400	320	640	7.4
39N 28W 14-1	Gd	5/14/64	USGS	----	13	36	14.2	159	45	6	----	231	223	391	8.5
39N 28W 19-3	Pc	5/14/64	USGS	----	34	31	20.3	250	25	13	----	257	221	469	7.9

Pc - Precambrian
Pa - Paleozoic
Gd = Glacial drift

FIELD ANALYSES OF WELL WATER

Well Number	Aquifer (Pc=Precambrian, Pa=Paleozoic, Gd=Glacial drift)	Date	Hardness ($CaCO_3$)	Iron (Fe)	Specific Conductance (Micromohs at 25°C)	pH	Temperature (°F)
44N 30W 23-1	Pc	10/21/64	140	0.7	260	8.0	--
33-1	Gd	10/19/64	240	0.2	375	7.5	--
44N 28W 27-1	Gd	9/9/64	190	---	240	---	--
43N 30W 11-1	Pc	8/5/64	170	<0.1	290	7.5	--
43N 29W 11-1 (Spring)	Gd	8/10/64	190	---	320	6.9	--
43N 28W 23-3	Gd	8/5/64	240	0.5	380	7.5	--
43N 27W 28-1	Pc	10/23/64	270	0.2	440	7.5	48
42N 30W 2-1	Pc	10/18/64	150	0.3	260	7.0	49
4-1	Pc	10/16/64	340	<0.1	590	7.0	48
18-2	Pc	10/15/64	210	0.2	325	8.0	--
24-1	Pc	10/16/64	130	4.0	215	7.5	46
33-1	Pc	10/15/64	320	<0.1	700	7.0	51
33-2	Pc	10/15/64	230	<0.1	410	7.5	47
42N 29W 19-1 (Spring)	Gd	10/21/64	270	<0.1	450	8.0	--
22-1	Gd	10/14/64	380	<0.1	700	6.5	54
22-2 (Flows)	Gd(?)	10/14/64	260	<0.1	510	7.5	42
31-1	Pa	11/18/64	220	<0.1	420	7.0	--
33-1	--	10/7/64	290	<0.1	410	7.0	53
42N 28W 5-5	Pa	10/23/64	220	0.7	320	7.5	45
32-1 (Spring)	Gd	9/17/64	640	---	1580	6.8	47
42N 27W 20-1	Pa	9/14/64	290	1.5	395	7.0	45
32-2	Pc	9/14/64	140	<0.1	300	7.5	--
41N 30W 16-1	Gd	11/18/64	150	0.2	300	8.0	--
25-3	--	11/19/64	240	<0.1	400	7.5	--
32-1	Pc	11/19/64	270	0.1	500	7.5	--

Field Analyses of Well Water.--Continued

Well Number	Aquifer (Pc=Precambrian, Pa=Paleozoic, Gd=Glacial drift)	Date	Hardness ($CaCO_3$)	Iron (Fe)	Specific Conductance (Micromohs at 25°C)	pH	Temperature (°F)
41N 28W 8-1	Pa	11/6/64	220	< 0.1	360	7.5	48
8-2	Gd	11/6/64	260	< 0.1	400	7.5	47
28-1 (Spring)	Gd	11/13/64	220	0.3	325	7.5	47
34-1	Gd	11/13/64	140	0.5	230	7.5	47
41N 27W 9-1	Pa	10/5/64	260	2.0	675	7.5	--
40N 30W 5-1	Gd(?)	12/10/64	150	---	275	8.0	51
6-1	Gd	1964	260	< 0.1	---	7.5	56
14-1	Pc(?)	1964	290	0.1	580	7.5	49
14-2	--	12/14/64	240	1.5	420	7.5	48
20-1 (Flows)	--	1964	220	0.1	385	7.0	49
23-1	Pc	1964	300	0.2	500	7.5	--
40N 29W 6-2	Gd	9/11/64	240	0.2	---	8.0	--
40N 28W 10-1	Pc	12/9/64	270	< 0.1	640	8.0	47
39N 29W 2-1	Gd	1964	---	---	480	---	50
14-2	Gd	12/15/64	170	0.1	340	7.5	--
15-1	Gd	12/15/64	260	1.5	420	7.5	--
20-1	Gd	1964	---	---	335	---	49
22-1	Gd	1964	250	0.2	460	---	53
26-1	Pc	1964	---	---	435	---	51
36-1	Pc	1964	---	---	525	---	53
36-2	--	1964	---	---	425	---	51
39N 28W 16-1	Pc	1964	---	---	380	---	50
24-1	Pa	9/16/64	---	---	540	---	51
30-8	Pc	12/15/64	310	< 0.1	480	7.5	--
35-1	Pa	1964	---	---	660	---	53

(< = Less than)

IRON COUNTY

WATER QUALITY

Laboratory Analysis of Ground Water - Iron County

Water-bearing aquifer: Pcr - Precambrian rocks
Pa - Paleozoic rocks
Gd - Glacial drift

Well Number	Aquifer	Date sampled	Temperature °F	Specific conductance (Micromhos @ 25°C)	pH	in parts per million							
						Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Hardness ($CaCO_3$)	Hardness (Non-carbonate)	Iron (Fe) Field Analysis
43N 32W 29-1	Pcr	9-24-65	46	784	7.5	358	0	108	30	0.1	416	122	0.1
43N 33W 31-1	Gd	9-23-65	--	338	7.3	210	0	7.2	1.0	1.6	182	10	4.0
45N 32W 5-2 (Spring)	Gd	9-30-65	45	208	7.8	114	0	28	2.0	0.1	106	12	0

Field Analyses of Ground Water from Iron County

Aquifer: Pcr - Precambrian rocks; Pa - Paleozoic rocks; Gd - Glacial drift.

Well Number	Aquifer	Date Sampled	In parts per million: Hardness	In parts per million: Iron	Specific conductance (Micromohs at 25°C)	pH	Temperature °F
41N 31W 14-1	Pcr	7-29-65	170	>4.0	385	7.5	46
41N 32W 11-1	Gd	8-26-65	150	0	240	7.2	48
42N 31W 6-1	Gd	7-29-65	170	0.3	285	7.5	44
6-2	Gd	8-12-65	90	0.15	290	6.5	48
42N 32W 26-1	Gd	7-30-65	90	0.2	180	7.7	--
42N 33W 15-1	Pcr	8-11-65	170	0	290	7.5	--
42N 3 42N 35W 20-2	Gd	9-27-65	50	0	80	6.0	45
43N 31W 4-1	Pcr	8-10-65	140	1.2	220	7.5	45
16-1	Pcr	8-11-65	310	0	480	7.0	--
33-1	Gd	7-16-65	170	0.6	295	7.0	46
36-2	Pcr	8-11-65	290	1.5	440	7.7	--
43N 32W 1-1	Gd	8-17-65	190	0.7	310	7.2	44
4-2	Gd	8-17-65	190	>4.0	310	7.5	45
43N 33W 21-1	Gd	5-11-65	170	0	280	7.5	--
27-2	Pcr	9- 9-65	290	0	520	7.0	--
27-3	Pcr	9- 9-65	240	0.7	400	7.2	--
43N 34W 24-1	Gd	8-11-65	150	0.4	245	7.5	--
43N 37W 33-3	Gd	9-22-65	30	1.5	<50	6.0	--
44N 31W 26-1	Gd	8-12-65	170	0.2	220	7.5	47
34-1	Pcr	8-10-65	220	<0.1	380	7.2	--
44N 32W 16-1	Gd	8-17-65	150	2.0	275	7.1	52
17-1	---	8-18-65	140	0	280	7.8	47
44N 33W 6-1	---	8-19-65	150	<0.1	235	7.7	--
7-1	Gd	8-18-65	150	1.0	170	7.8	46
7-2	Pcr	8-18-65	120	0	225	7.7	--
17-1	Gd	8-18-65	170	0	310	7.7	--
35-1	Gd	8-12-65	150	0	270	7.7	--
45N 31W 7-1	Gd	8-25-65	100	0	205	7.1	52
24-1	Gd	8-25-65	200	0	360	7.5	--
25-1	Gd	8-25-65	120	0.5	225	7.0	--
26-1	Pcr	8-25-65	120	<0.1	220	8.0	--
45N 32W 5-1	Gd	8-13-65	70	>4.0	125	6.5	46
29-1	Gd	8-13-65	90	<0.1	165	7.0	45
45N 33W 8-2	Gd	8-19-65	100	2.0	175	7.9	46
46N 31W 30-1	Gd	11-11-65	20	1.0	50	6.0	45
46N 33W 6-1	Pcr	8-19-65	140	0	290	7.5	--

Well No.: 42N 34W 9-1

Laboratory analysis by Michigan Department of Health (collected July 1959)

Silica (SiO_2)	12	ppm
Iron (Fe)	0	
Calcium (Ca)	46	
Magnesium (Mg)	23	
Sodium and Potassium (Na+K)	3.1	
Chloride (Cl)	1	
Sulphate (SO_4)	24	
Bicarbonate (HCO_3)	228	
Total hardness ($CaCO_3$)	210	
Fluoride (F)	0	
Total solids	225	

Field analysis by U. S. Geological Survey (July 1965)

Specific conductance (Micromhos at 25°C)	400
pH	7.5
Iron	0

Well No.: 42N 35W 1-2

Laboratory analysis by Michigan Department of Health (collected July 1959)

Silica (SiO_2)	14	ppm
Iron (Fe)	0	
Calcium (Ca)	39	
Magnesium (Mg)	15	
Sodium and Potassium (Na+K)	3.6	
Chloride (Cl)	2	
Sulphate (SO_4)	27	
Bicarbonate (HCO_3)	171	
Total hardness ($CaCO_3$)	160	
Fluoride (F)	0	
Total solids	182	

Field analysis by U. S. Geological Survey (May 1965)

Specific conductance (Micromhos at 25°C)	310
pH	7.5
Iron	0
Temperature (°F)	44

Well No.: 43N 35W 26-3 city well No. 1

Laboratory analysis by Michigan Department of Health
(city well No. 1, July 1959)

Silica (SiO_2)	16 ppm
Iron (Fe)	0.2
Calcium (Ca)	106
Magnesium (Mg)	45
Sodium and Potassium (Na+K)	6.5
Chloride (Cl)	8.0
Sulphate (SO_4)	220
Bicarbonate (HCO_3)	285
Total hardness ($CaCO_3$)	451
Fluoride (F)	0.1
Total solids	590

Field test by U. S. Geological Survey
(May 1965)

Specific conductance (Micromhos at 25° C)	700
pH	7.0
Iron (ppm)	0.25
Temperature (°F)	50

Laboratory Analysis by Michigan Department of Health

43N 32W 21-3 (collected July 1965) **43N 32W 21-4**

	Well No. 2	Well No. 3
Silica (SiO_2)	13 ppm	14 ppm
Iron (Fe)	1.0	1.5
Calcium (Ca)	38	35
Magnesium (Mg)	13	9.8
Sodium and Potassium (Na+K)	4.7	3.5
Chloride (Cl)	1.0	0
Sulphate (SO_4)	24	5
Bicarbonate (HCO_3)	161	161
Total Hardness ($CaCO_3$)	150	128
Fluoride (F)	0	0
Total Solids	190	154

A flowing well on the east edge of the business district, known as Crystal Mineral Spring, was drilled many years ago as an iron ore test hole.

Laboratory analysis by U. S. Geological Survey
(collected September 24, 1965)

	Well 43N 32W 29-1
Bicarbonate (HCO_3)	358 ppm
Carbonate (CO_3)	0
Sulphate (SO_4)	108
Chloride (Cl)	30
Nitrate (NO_3)	0.1
Hardness ($CaCO_3$)	416
Hardness (Noncarbonate)	122
Iron (Fe) Field test	0.1
Specific conductance (Micromhos at 25°C)	784
pH	7.5

42N 33W 12-1

Laboratory analysis well No. 1 by Michigan Department of Health
(collected February 1961--before treatment)

Silica (SiO_2)	11 ppm
Iron (Fe)	1.4
Calcium (Ca)	20
Magnesium (Mg)	11
Sodium and Potassium (Na+K)	2.5
Chloride (Cl)	0
Sulphate (SO_4)	22
Bicarbonate (HCO_3)	97
Total hardness ($CaCO_3$)	95
Fluoride (F)	0
Total solids	126

Laboratory analysis by Michigan Department of Health

	42N 35W 11-1 Well #1 (July, 1959)	42N 34W 13-1 Well #2 (Aug., 1959)
Silica (SiO_2)	15 ppm	14 ppm
Iron (Fe)	0	0.1
Calcium (Ca)	32	53
Magnesium (Mg)	16	30
Sodium and Potassium (Na+K)	3.2	3.3
Chloride (Cl)	0	10
Sulphate (SO_4)	18	13
Bicarbonate (HCO_3)	159	290
Total hardness ($CaCO_3$)	144	254
Fluoride (F)	0.1	0
Total solids	170	274

Laboratory Analysis of well No. 3 by Michigan Department of Health
(collected July 1965)

	44N 33W 8-3
Silica (SiO_2)	12 ppm
Iron (Fe)	0.4
Calcium (Ca)	54
Magnesium (Mg)	21
Sodium and Potassium (Na+K)	30.1
Chloride (Cl)	37
Sulphate (SO_4)	37
B carbonate (HCO_3)	222
Total hardness ($CaCO_3$)	222
Fluoride (F)	0
Total solids	322

42N 33W 12-1

Field analysis well No. 1 by U. S Geological Survey
(July 1965)

Specific conductance (Micromhos at 25°C)	195
pH	7.0
Iron (ppm)	0.7
Temperature (°F)	46

Laboratory analysis by Michigan Department of Health

	44N 33W 16-1 Well No. 1 (July, 1959)	43N 33W 14-1 Well No. 2 (July, 1959)	44N 33W 16-2 Well No. 3 (June 7, 1965)
Silica (SiO_2)	13 ppm	11 ppm	-- ppm
Iron (Fe)	0	0.1	0.2
Calcium (Ca)	40	30	--
Magnesium (Mg)	20	14	--
Sodium and Potassium (Na+K)	4.8	3.1	--
Chloride (Cl)	6	0	1
Sulphate (SO_4)	13	11	--
Bicarbonate (HCO_3)	200	150	--
Total hardness ($CaCO_3$)	182	132	160
Fluoride (F)	0	0	0.1
Total solids	244	158	--
Manganese (Mn)	--	--	0
Nitrates	--	--	0.5
Nitrates	--	--	.01
pH	--	--	8.1

Laboratory Analysis by Michigan Department of Health
(collected November 24, 1964)

	43N 34W 28-1 Well No. 1	43N 34W 28-2 Well No. 2
Silica (SiO_2)	10 ppm	10 ppm
Iron (Fe)	0	0
Manganese (Mn)	0	0
Calcium (Ca)	42	48
Magnesium (Mg)	18	21
Sodium (Na)	2.0	2.3
Potassium (K)	1.0	1.4
Nitrate (NO_3)	1.3	0.6
Chloride (Cl)	0	0
Sulphate (SO_4)	33	37
Bicarbonate (HCO_3)	200	225
Carbonate (CO_3)	0	0
Hardness ($CaCO_3$)	180	205
Fluoride (F)	0	0
Total solids	180	220
pH	7.7	7.5
Specific conductance (Micromhos at 25°C)	390	420

Laboratory analysis by Michigan Department of Health
(collected July 1959)

	43N 35W 16-1 Ryden	43N 35W 21-1 Nash
Silica (SiO_2)	12 ppm	13 ppm
Iron (Fe)	0	0
Calcium (Ca)	32	36
Magnesium (Mg)	19	22
Sodium and Potassium (Na+K)	2.5	2.9
Chloride (Cl)	0	0
Sulphate (SO_4)	5	11
Bicarbonate (HCO_3)	154	174
Total hardness ($CaCO_3$)	132	158
Fluoride (F)	0	0
Total Solids	148	172

MARQUETTE COUNTY

WATER QUALITY

CHEMICAL ANALYSES OF WATER FROM WELLS
(ANALYSES ARE GIVEN IN MILLIGRAMS/LITER)

Township and Range	Section No	Well No	Location within section ¼	¼	Date Sampled	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Total Dissolved Solids	Total Hardness as $CaCO_3$	Specific Conductance (micromhos at 25°C)	pH
42N 24W	2	1	[illegible]	NW	7-16-7[illegible]	72	22	—	—	—	298	85	5.0	7.0	—	272	460	7.6
	"	2	SE	NW	"	72	18	—	—	—	293	25	1.0	1.0	—	246	440	—
[illegible]	1	1	SE	NE	9/[illegible]/70	101	[illegible]	—	—	—	307	10	[illegible]	0	—	280	480	—
[illegible]	7	1	SW	NW	9/9/70	57	27	—	—	—	303	10	1.0	0	—	252	440	—
	[illegible]	1	SE	SE	9/[illegible]/70	93	33	—	—		525	15	16	0	—	366	650	7.5
	[illegible]	1	NE	NE	"	81	25	—	—	—	342	20	14	0	—	306	520	—
	[illegible]	2	NE	NW	"	72	30	—	—	—	332	45	2.0	4.5	—	326	540	—
[illegible]	[illegible]	1	SE	SE	"	[illegible]	33	—	—	—	343	85	22	1.9	—	352	580	—
	5	1	SW	NW	9/[illegible]/70	70	16	—	—	—	293	5	0	0	—	240	420	—
43N [illegible]W	2[illegible]	1	SW	SW	9/[illegible]/70	51	20	—	—	—	256	10	3.0	0	—	210	[illegible]	—
[illegible]	[illegible]	1	NE	NE	"	44	25	—	—	—	280	15	0	.2	—	240	400	—
[illegible] 25W	5	1	SE	SW	9/[illegible]/70	62	13	—	—	—	259	10	1.0	0	—	208	360	—
	21	1	SW	W	9/10/70	74	22	—	—	—	371	10	4.0	0	—	316	500	—
[illegible]	21	1	SW	SW	9/9/70	45	34	—	—	—	288	10	3.0	0	—	250	380	—
	20	1	SW	NW	"	92	22	—	—	—	393	5	8.0	33	—	320	650	—
[illegible]	27	1	SW	NW	9/[illegible]/70	84	30	—	—	—	422	20	27	1.6	—	356	750	—
	[illegible]	1	SW	NE	"	84	34	—	—	—	349	15	14	0	—	310	540	
44N [illegible]	25	1	NW	SE	9/16/70	103	18	—	—	—	307	65	22	1.5	—	328	600	
[illegible] 23W	7	1	NE	SE	9/23/70	118	46	—	—	—	393	5	187	0	—	482	1000	
	[illegible]		NW	SW	9/[illegible]/70	30	12	—	—	—	149	5	2.0	1.8	—	124	240	
	[illegible]		NE	NE	"	42	19	—	—	—	190	15	13	2.3	—	184	320	
[illegible] 24W	5	1	SW	SW	7/7/64	17	1.8	2.3	.9	—	52	14	2.2	—	74	50	125	
[illegible]		1	SW	[illegible]	9/[illegible]	30	5.2	11	7.9	1.6	78	26	28	.02	151	96	274	—
	[illegible]	1	NW	[illegible]	9/10/63	22	6.2	3.4	2.1	.20	88	13	4.0	.02	106	80	178	
[illegible]	15	1	SW	NE	"	17	11	2.5	1.8	.3[illegible]	118	10	1.0	.01	10[illegible]	100	199	
[illegible]	[illegible]		NE	SE	8/[illegible]	12	3.0	1.2	.5	.44	61	9.6	3.0	.08	65	57	123	
46N [illegible]	6	1	SE	SE	9/22/70	31	8.3	—	—	—	49	45	60	1.6	—	112	360	—
	25	1	SE	W	"	34	17	—	—	—	168	10	0	0	—	152	260	

CHEMICAL ANALYSES OF WATER FROM WELLS
(ANALYSES ARE GIVEN IN MILLIGRAMS/LITER)

Township and Range	Section No	Well No	Location within Section ¼	¼	Date Sampled	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Total Dissolved Solids	Total Hardness as $CaCO_3$	Specific Conductance (micromhos at 25°C)	pH
	29	1	SW	NW	9/28/70	24	10	—	—	—	102	15	4.0	0	—	100	180	—
	29	2	SE	SE	9/30/70	36	.15	—	—	—	159	10	3.0	0	—	150	260	—
	32	1	NW	SE	9/28/70	51	15	—	—	—	178	15	52	.6	—	190	420	—
46N 24W	23	1	SE	SW	9/30/70	18	7.3	—	—	—	46	10	1.5	2.8	—	76	340	—
	26	1	NW	NW	9/30/70	24	6.3	—	—	—	120	0	2.0	0	—	86	160	—
46N25W	9	1			7/24/63	13	6.9	1.9	1.2	3.0	75	6.8	3.0	.06	83	60	137	6.0
	11	1			7/26/63	12	1.4	1.5	.7	—	44	2.2	1.5	—	48	36	77	7.4
	16	1			7/24/63	20	4.4	4.6	4.4	.47	79	18	9.5	.06	96	68	190	[illegible]
	36	5			6/19/63	19	3.6	1.7	.9	.04	80	4.4	1.5	—	81	62	128	7.7
	36	6			"	17	3.4	.9	.7	.04	60	8.6	2.5	—	72	56	118	8.0
46N 26W	12	1			7/9/64	7.1	1.8	1.6	.6	—	24	11	2.0	—	50	25	69	7.6
	31	1			9/10/64	28	7.0	3.1	1.4	—	90	30	0	0	126	99	212	6.6
46N 27W	17	1			8/28/63	21	6.2	3.1	1.2	1.6	79	20	2.0	.1	102	78	175	6.7
	19	1			7/8/64	9.0	2.0	2.0	.8	—	23	5.6	1.0	—	51	30	80	9.3
	31	1			8/28/63	14	6.4	2.0	1.0	1.5	66	7.6	2.0	—	68	62	127	6.8
46N 28W	1	1			"	15	6.3	1.6	1.2	.23	47	4.8	8.5	.30	69	64	136	8.5
	8	1			"	4.0	1.9	1.2	.5	.50	16	7.4	9.5	.06	33	18	62	6.2
	15	1			7/8/64	11	3.5	.9	1.2	—	48	4.4	1.0	—	51	42	90	7.7
	27	—			"	16	3.1	2.3	1.2	—	51	15	2.8	—	75	53	128	7.5
	32				8/28/63	16	4.9	1.6	.7	—	51	26	5.0	.06	84	60	144	6.6
46N 29W	18	5			"	23	5.8	2.4	2.6	.45	93	20	10	.06	115	82	209	6.6
•	22	1			"	8.6	2.7	1.8	1.0	—	24	16	3.0	.03	45	32	85	[illegible]
	30	1			9/6/63	30	14	3.1	1.0	.10	102	13	29	0	160	133	240	7.[illegible]
	36	1			8/28/63	16	5.4	4.4	2.6	—	76	17	3.0	.03	88	62	154	6.[illegible]
47N 24W	28	1			7/8/64	18	7.4	2.6	2.3	—	73	24	2.0	—	105	76	178	7.[illegible]
47N 2[illegible]W	12	1			"	18	4.5	3.8	2.5	—	44	34	4.0	—	96	62	162	7.5
	15	1			9/[illegible]/63	34	8.7	2.2	.6	.08	140	10	1	.01	131	121	238	7.3
	19	1			7/[illegible]	48	14	5.6	3.0	—	80	105	10	—	258	178	387	7.3

CHEMICAL ANALYSES OF WATER FROM WELLS
(ANALYSES ARE GIVEN IN MILLIGRAMS/LITER)

Township and Range	Section No	Well No	Location within Section ¼	¼	Date Sampled	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Total Dissolved Solids	Total Hardness as $CaCO_3$	Specific Conductance (micromhos at 25°C)	pH
	20	1			7/25/63	22	5.2	3.1	1.6	8.1	74	27	5.5	—	108	76	188	6.4
	21	1			7/16/64	—	—	—	—	—	73	25	4.5	—	—	75	186	7.1
	22	1			8/28/63	41	11	2.9	1.7	—	134	46	1.0	.04	186	147	304	6.7
	32	1			7/24/64	18	3.5	2.7	1.9	.25	63	17	4	4.5	86	60	151	6.7
47N28W	3	1			10/17/62	25	6.8	2.0	.6	5.6	107	3.6	1.0	—	127	90	181	6.8
	8	1			7/8/64	41	—	9.4	3.4	—	103	49	13	—	194	125	306	7.5
	15	1			"	10	—	3.7	2.3	—	18	7.5	—	—	64	36	110	9.7
	28	1			8/28/63	16	—	7.4	5.3	.38	82	18	4.0	.02	103	67	187	6.6
	35	1			8/8/64	19	—	3.6	2.3	—	65	25	1.8	—	106	68	168	7.4
47N26W	19	1			9/28/61	25	16	9.0	.3	1.4	172	8.8	1.0	0	154	129	272	7.2
	24	1			7/25/63	45	9.2	9.6	3.3	2.4	86	88	32	.15	228	190	440	6.9
	25	1			7/24/63	43	13	7.7	3.3	1.6	92	84	12	3.2	217	161	363	6.5
	25	2			7/9/64	12	4.9	3.3	4.0	—	42	24	3.0	—	88	50	133	8.0
	25	3			"	40	11	8.8	3.0	—	94	83	8.0	—	238	145	347	7.1
	26	1			"	8.2	4.3	1.2	.2	—	39	3.2	1.0	—	87	38	77	6.9
	36	1			"	30	2.5	4.8	2.2	—	27	71	7.0	—	157	86	224	7.2
	36	9			5/28/64	—	—	—	—	—	130	5.6	1.5	—	—	109	204	7.5
47N29W	2	1			9/6/63	5.7	2.0	1.8	.8	.14	28	10	0	.02	34	22	62	6.6
	3	1			"	24	9.9	22	1.9	.23	20	15	80	.02	207	101	348	6.3
	34	1			8/28/63	13	5.8	2.2	1.2	.66	85	1.6	2.0	.02	94	56	151	6.6
	36	1			"	15	6.4	2.6	1.2	.86	68	13	3.0	.02	83	64	145	6.7
48N26W	34	1			7/8/64	25	4.7	.9	2.0	—	92	5.2	4.5	—	102	82	169	7.8
48N28W	30	1			8/28/63	7.0	2.9	1.5	1.0	.29	40	1.8	0	.03	—	36	30	6.5
48N29W	19	1			7/8/63	23	3.5	2.3	1.1	—	86	5.2	1.8	—	100	72	148	8.1
	26	1			8/28/63	2.8	1.1	1.2	.5	0.62	26	52	1.0	0.01	26	12	48	6.9

MENOMINEE COUNTY

WATER QUALITY

Chemical analyses of water samples from lower sandstones

(analyses by the U. S. Geological Survey except as noted)

Well number	Date collected	Chemical constituents (parts per million)										Specific conductance (micromhos at 25° C)	pH
		Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Dissolved solids	Hardness as $CaCo_3$		
37N 28W 11-1	4- 5-63	.33	88	37	3.4	1.4	306	97	27	460	372	681	7.7

Chemical analysis of water samples from the glacial drift

(analyses by the U. S. Geological Survey except for 38N 28W 5-1 by the Michigan Department of Health)

Well Number	Date collected	Chemical constituents (parts per million)											Specific conductance (micromhos at 25°C)	pH
		Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCo_3$		
38N 28W 5-1	4- 5-63	.48	94	39	36	1.2	408	41	17	97	533	395	846	7.9
38N 28W 5-1	8-15-63	.1	--	--	--	---	---	--	15	19	---	390	---	---

Chemical analyses of water samples from middle limestones and sandstones

(analyses by the U. S. Geological Survey)

Well number	Date collected	Chemical constituents (parts per million)										Specific conductance (micromhos at 25°C)	pH
		Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Dissolved solids	Hardness as $CaCo_3$		
37N 27W 1-1	5- 7-62	.93	57	33	3.8	2.2	288	42	7.0	309	278	524	8.1